DOCUMENT RESUME

ED 239 911 SE 043 909

AUTHOR	Cannon, Esther; And Others
TITLE	An Energy Environment Education Program for Grade 3.
INSTITUTION	San Diego County Dept. of Education, Calif.
PUB DATE	78
NOTE	188p.; For related documents, see SE 043 910-911.
PUB TYPE	Guides - Classroom Use - Guides (For Teachers) (052)
EDRS PRICE	MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	Art Activities; Elementary School Science; *Energy; *Energy Conservation; Energy Occupations; *Environmental Education; Fuels; Grade 3; *Learning Activities; Primary Education; *Recycling; Science Activities; Social Studies
IDENTIFIERS	Alternative Energy Sources; *Energy Education

ABSTRACT

This curriculum guide contains 45 interdisciplinary energy and environmental education activities to help students apply knowledge of energy uses to energy conservation in the home and develop an awareness of their own social responsibilities for energy consumption. Each activity, designed to meet one of six objectives, includes: (1) statement of topic or concept fostered; (2) list of materials needed; (3) teacher information; (4) procedure(s); and (5) evaluation methods. Materials to accompany selected activities, list of goals and objectives for energy education in San Diego County, and energy fact sheets are provided in appendices. Also provided in introductory sections are: brief comments for teachers on energy sources, energy forms, and renewable and non-renewable energy sources; sources of additional energy materials (including organization name and address); list of suggested art activities; and instructions for preparing a bulletin board on "energy in the news." (JN)

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ENERGY
ENVIRONMENT
EDUCATION

Program for Grade 3

Superintendent of Schools, Department of Education, San Diego County

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ENERGY/ENVIRONMENT EDUCATION

GRADE 3

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1977

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San Diego, California
1978
Unedited

PREFACE

Nature never gives anything away.
Everything is sold at a price.
It is only in the ideals of abstraction
that choice comes without consequence.

--Ralph Waldo Emerson

In 1976 America celebrated its 200th birthday. For about 195 of these 200 years Americans were coaxed, implored, and cajoled to consume, consume, consume. Even the hearty pioneer viewed the forests and prairies as something to be conquered and used and, when they wore out, to move on. In later years the massive efforts of Madison Avenue were to convince Americans that they should buy "more" and "bigger" everything. By the 1950's and 60's the automobile had become a symbol of wealth and prestige and the value of an automobile was measured by its horsepower, its power equipment, and the amount of chrome it carried. Americans were led to believe "there was no tomorrow" or that tomorrow would be even more rosy than today.

Occasionally in our history we had small warning signs, such as the dust bowl of the 1930's, but generally the cries of the conservationist and the ecologist were brushed off as being those of doomsday sayers and of the radical fringe. It is no wonder then that Americans were genuinely surprised and shocked when they had to stand in gasoline lines in 1973. Other warning signs quickly followed in the form of blackouts and brownouts in major American cities. In the winter of 1976-77 most of the East Coast of the United States suffered from severe shortages of natural gas and other heating fuel. By the bicentennial year gasoline rationing was a topic for serious consideration.

And so, as the nation enters its third century, Americans' views on energy and the environment are slowly beginning to change, often against their will. But the task of re-educating the American people to a more sensible and rational perspective on energy and environment has only just begun. Adults, trained for most of their lives to believe that there is an endless supply of energy and natural resources, continue to question the need for conservation. Their attitudes are epitomized by a recent newspaper article from drought-stricken Marin County which told of a young man washing down his driveway with water which should have been put to much better use. When confronted, he replied, "I can afford it, can't I?" and the newspaper caption read, "Yes, but can we afford you?" Deeply engraved attitudes of indulgence and waste are still being passed on to children. We still live in the disposable, throw-away, bigger and faster age. Energy and environmental constraints indicate that this life-style can no longer continue.

America's schools are often called on to bring about change of attitude in American society. Undoubtedly, then, it would be the schools that play the leading role in helping the new generations to develop healthier and more rational views of energy and the environment. It was with this in mind that this curriculum project was undertaken. It is the sincere hope of all who worked on it that the ideas and activities contained in this project will be an initial step in helping the children of our schools develop thought patterns and actions which will result in a more thoughtful use of energy and the environment.

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ORIGINS OF THIS PROJECT

For the past three years, a committee consisting of representatives from San Diego City Schools, San Diego County Schools, and a variety of community groups has been meeting to discuss energy education plans for San Diego County. This group is known as the San Diego City/County Energy Education Committee. In the fall of 1976, a subcommittee met and formulated a proposal for a funding grant from the State of California Environmental Educational Grant Fund (state individualized license plate money). The grant was awarded and in the spring of 1977 a review of all available materials related to energy education was undertaken.

In the summer of 1977, a major curriculum writing project was undertaken which resulted in the production of primary grade and upper elementary grade curriculum guides containing activities and materials for teaching energy and environmental education in the classroom. This writing was undertaken by the elementary resource staff members of social studies and science from San Diego City Schools assisted by eight elementary classroom teachers. The result is a publication which contains practical classroom activities arranged in a thoughtful sequence. The writing team consisted of persons with expertise in social studies, science, and art and has given a multidiscipline perspective to energy/environmental education.

During the summer of 1978, a major rewriting of the energy/environment guides was undertaken. A team of city and county school teachers worked together to produce guides for grades 1, 3, 4 and 6. The guides for grades 1 and 4 emphasize basic science concepts involving energy that will enable students to apply that knowledge to social issues in grades 3 and 6. Grades 2 and 5 will utilize the SDG&E materials.

The continuing need for energy/environmental education is apparent, since the factors related to our energy/environmental status is constantly changing. Energy/environmental education cannot be static. It must continue to change to better assist students in making wise decisions as they become the energy consumers of the future.

GOAL AND OBJECTIVES

Goal: Students will apply knowledge of energy uses to energy conservation in the home and develop awareness of their own social responsibilities for energy consumption.

Objective 1: Students will identify forms and sources of energy.

Objective 2: Students will identify examples of environmental concerns that are energy-related.

Objective 3: Students will give examples of activities that involve energy consumption as well as an economic cost. (The real cost of anything is what you give up to get it.)

Objective 4: Students will give examples of how limited natural resources affect the way people live.

Objective 5: Students will give examples of career opportunities in the area of energy and ecology.

Objective 6: Students will explain social responsibility for energy consumption.

ADDITIONAL ENERGY MATERIALS

In addition to library materials which you have available for use in your classroom, you can visit the San Diego Ecology Centre, Inc., 340 Kalmia St., San Diego, CA 92101, and write to the sources listed below.

American Gas Association
1515 Wilson Boulevard
Arlington, VA 22209

American Nuclear Society
San Diego Chapter
P. O. Box 81451
San Diego, CA

American Nuclear Society
National Office
244 East Ogden Ave.
Hinsdale, IL 60521

American Petroleum Institute
1801 "K" Street NW
Washington, DC 20006

American Public Power Association
2600 Virginia Avenue NW
Washington, DC 20037

Atomic Industrial Forum
475 Park Avenue South
New York, NY 10016

Citizens' Advisory Committee on
Environmental Quality
1700 Pennsylvania Ave. NW
Washington, DC 20006

Ecology Forum
124 East 39th Street
New York, NY 10016

Edison Electric Institute
90 Park Avenue
New York, NY 10016

Thomas Alva Edison Foundation
Cambridge Office Plaza, Suite 143
18280 West Ten Mile Rd.
Southfield, MI 48075

Electrical Industries Association
6055 E. Washington Blvd
Los Angeles, CA 90040

Energy Conservation Research
9 Birch Road
Malvern, PA 19355

Energy Information Center
100 California St.
San Francisco, CA 94111

Energy Research and Development Adm.
Dept. of Energy
Office of Public Affairs
Washington, DC

Environmental Action Foundation
724 Dupont Circle Building
Washington, DC 20036

EXXON, USA
Public Affairs Dept.
P. O. Box 2180
Houston, TX 77001

Federal Energy Administration
Dept. of Energy
111 Pine Street
San Francisco, CA 94111

Foundation for Alternative Energy
407 N. Maple Drive
Beverly Hills, Ca 90210

Interstate Oil Compact Commission
Educational Department
P. O. Box 53127
Oklahoma City, OK 73105

National Coal Association
1130 17th St. NW
Washington, DC 20036

National Interviews
153 E Street SE
Washington, DC 20003

National Solar Heating and Cooling
Information Center
P. O. Box 1607
Rockville, MD 20850

National Audubon Society
1412 - 16th Street NW
Washington, DC 20036

San Diego Ecology Centre
340 Kalmia St.
San Diego, CA 92101

San Diego Gas and Electric
P.O. Box 1831
San Diego, CA 92112

Scientists Institute for Public
Information
30 East 68th St.
New York, NY 10021

Shell Oil Company
Public Affairs
P. O. Box 2463
Houston, TX 77001

Sierra Club
1051 Mills Tower
San Francisco, CA 94104

Sierra Club San Diego Chapter
1549 El Prado
San Diego, CA 92101

State Energy Resources Conservation
and Development Commission
1111 Howe Ave.
Sacramento, CA 95825

U.S. Environmental Protection Agency
401 "M" Street SW
Washington, DC 20240

U.S. Department of Interior
18th and C Street NW
Washington, DC 20240

TEACHER BACKGROUND

Energy Sources

The sun is the ultimate source of nearly all of the energy consumed on earth. (The exception is nuclear energy.) Most people are unaware of this, because the manner in which solar energy comes to our use is frequently obscured by intermediate steps.

Convection and evaporation are two of these processes. Convection makes the sun's energy available to us quickly and more or less continuously. Heat is converted to air motion, but there is no significant storage of energy. Evaporation also depends on continued heating, but at any given moment there is an appreciable amount of energy stored in water previously lifted which has not yet returned to sea level.

The most important process through which solar energy comes to our use is called photosynthesis. Photosynthesis is the process by which every green plant is able to use solar energy *directly* to do the work necessary to build its own complex molecular structures from the simpler molecules in the plant's environment. This process is important because (1) it is the beginning of the food chain, which provides energy to all living things, and (2) it is the origin of all fossil fuels.

If plants provide fuel for the other living things, it follows that the growth of plants must be a process of energy storage. The energy is stored in the chemical bonds which hold the plant's molecules together. It is put into storage when the molecules are assembled during growth. It may be taken out by digestion, combustion, or any other process which disassembles the molecules.

What we now know as fossil fuels are ancient deposits of plant and animal life. Coal has been changed by varying amounts of time, heat and pressure to its present high carbon content forms. Petroleum consists of the remains of marine plants and animals which, though long dead, still contain large, complex molecules whose connecting bonds yield abundant energy when the bonds are broken. This biological process yields food as well as fuel.

Every living thing on earth which does not have photosynthesis capability *must* feed, directly or indirectly, on things which do. Every animal, for example, eats either vegetable matter, or it eats other animals which eat vegetable matter.

Energy Forms

The forms of energy are somewhat arbitrary divisions of a single thing: energy, which is the capacity to do work. These divisions are useful in predicting the properties of a particular form of energy, or in understanding where certain energy comes from. Related to the concept of forms of energy is the knowledge that energy can be converted from one form to another. Energy conversion takes place all around us all the time. Conversion processes are the link which connects the systems which consume energy (living things, geophysical systems such as weather, machines, etc.) with earth's primary energy source, the sun.

Heat energy is converted to mechanical energy during evaporation, in that water is lifted, and during convection, in that air is set in motion. Light energy is converted to chemical energy during photosynthesis. A flashlight cell releases electrical energy which it converts from chemical energy stored in it during manufacture. Electrical energy is, in turn, converted to light and heat energy in the flashlight bulb.

Energy which is stored is more difficult to observe than is energy in action. For example, any combustible material is a storehouse of chemical energy. It is only when the energy is released, in the dramatic display of fire that we become conscious of its presence. Food energy is another example of chemical energy. Digestion is the process which releases it for use by living organisms.

Renewable and Non-renewable Energy Sources

The energy which reaches us from the sun may be divided as follows:

1. Energy which is continuously available. We can use it all without using it up.

2. Energy which is replenished fairly rapidly. If we are careful, it won't be used up.

3. Energy which takes so long to replenish that once we use it up, we won't live until it is replenished.

The energy in wind and falling water is constantly replenished by the sun (during daylight hours). This continuously available energy is like a salary paid at regular intervals. In contrast, let us look at vegetation, a savings account which is often replenished, and fossil fuels, a long-term savings account.

Vegetation is a quickly replenished savings account for energy. Wood can be produced in a generation or less. A substantial amount of alcohol can be produced by fermentation of a single year's crop of a starchy material, such as potatoes. Both wood and alcohol can be burned to produce steam which, as you know, can do a lot of work. Alcohol can also be used in automobile engines. So long as we don't use it faster than nature can produce it, this sort of energy is inexhaustible.

In contrast, fossil fuels, such as coal and petroleum, were formed millions of years ago and required at least tens of thousands of years to form. Most important, they are being replenished, if at all, at a rate which would require us to wait hundreds of generations for new deposits to form. Imagine a checking account containing a million dollars which is replenished at a rate of five hundred dollars a year. It seems like a lot, but, once the balance is spent, it will take many lifetimes to replenish it. Fossil fuels are nonrenewable in the sense that neither we, nor our great-great-grandchildren, nor any later generation we can imagine, will be around to see them replaced. There is a lot of controversy as to how much fossil fuel is left on earth, but it seems clear that at our present rate of consumption we will use up in two to ten generations the energy savings that it took hundreds of generations to accumulate.

SUGGESTED ART PROJECTS

1. Make a giant scrapbook or accordion of pictorial representations of energy concepts. Make it accessible to the children throughout the time that the unit is being studied.

2. Certain projects are designated as murals, posters, charts, collages, etc., primarily to add variety to the kinds of projects being done. Any project suggested as a mural could be compressed into a scrapbook page. The opposite is also true.

3. Since one of the major behavioral objectives is the conservation of energy, use scrap or discarded paper, or paper that has already been used on one side. For example, two murals, charts, or posters could be made back to back on the same piece of paper.

4. Have children bring in plastic containers from home to hold water, art materials, and serve as palettes.

5. Teach children to use all art materials conservatively, since wasting art materials costs both money and energy.

6. Some children may want to make individual scrapbooks or folders during their study of energy. Encourage them to do so.

7. Whenever possible display art projects where other children in the school can see them, so that they will become more aware of the energy problems.

8. Remember that aesthetics are important in all art projects even though the purpose of these projects is to teach about energy. The children should always be encouraged to make their projects attractive and to evaluate them from that point of view.

BULLETIN BOARD--"ENERGY IN THE NEWS"

Learning: Energy is in the news--locally, statewide, nationally, and globally.

Materials: A bulletin board, news articles.

Teacher Information: During the course of this unit, there will be articles in the newspaper and/or in magazines that will have a particular relevance to the concepts being developed. A bulletin board (perhaps entitled "Energy in the News") would keep information up-to-date and would reinforce the growing importance of energy issues to all of us.

Procedure: The bulletin board might be divided into the four categories listed in the learning so that as the article is reported, it could be placed in the appropriate section to reinforce the geographic perspective of the article.

Have students bring in newspaper and/or magazine articles. Have the student summarize the article for the class. Discuss the article so that it is meaningful to students.

Add the article to the bulletin board, having the student place it in the appropriate section.

Evaluation: At the end of each week, do a quick inventory of the bulletin board to see what the energy news for the week was:

1. What energy sources were reported?
2. What specific energy problems were identified?
3. Were the articles mostly local? State? National? Global?

GOAL 1: STUDENTS WILL APPLY KNOWLEDGE OF ENERGY USES TO ENERGY CONSERVATION IN THE HOME AND DEVELOP AWARENESS OF THEIR OWN SOCIAL RESPONSIBILITIES FOR ENERGY CONSUMPTION.

OBJECTIVE 1: *Students will identify forms and sources of energy and energy conversion.*

ACTIVITY 1

Learning:

1. Energy is the capacity to do work (to make things happen).
2. Energy can be moved from one place to another.
3. Energy may change form (heat, chemical, sound, mechanical, light, electrical)
4. The original source of all the energy stored in foods and fuels is the sun; the original source of *nearly* all our electrical energy is the sun. (Electrical power produced by nuclear reactors is the exception.)

Materials: Paper, crayons, pencil. Diagrams of electrical power production: "Electricity from Water," Appendix A-1; "Electricity from Gas Turbines," Appendix A-2; "Electricity from Fossil Fuels," Appendix A-3.

Teacher Information: For background information see page 5.

Procedure: Tell students that energy is the capacity to do work or make things happen. Ask them to give examples of energy in use.

Looking at one or several examples, ask students:

1. "In what form is the energy?"
2. "From where did the energy come? In what form was it then?"
3. Repeat 2 until you have completed the energy chain to the sun.

For example, in making toast:

Energy in the form of heat toasts the bread. Energy in the form of light is also present.

The heat and light energy came from electrical energy (form) which comes to our homes through wires.

The electrical energy was produced using hydro power (mechanical energy of moving water) or from fossil fuels (chemical energy) or nuclear energy.

The water behind dams was listed by the sun's energy in the process of evaporation.

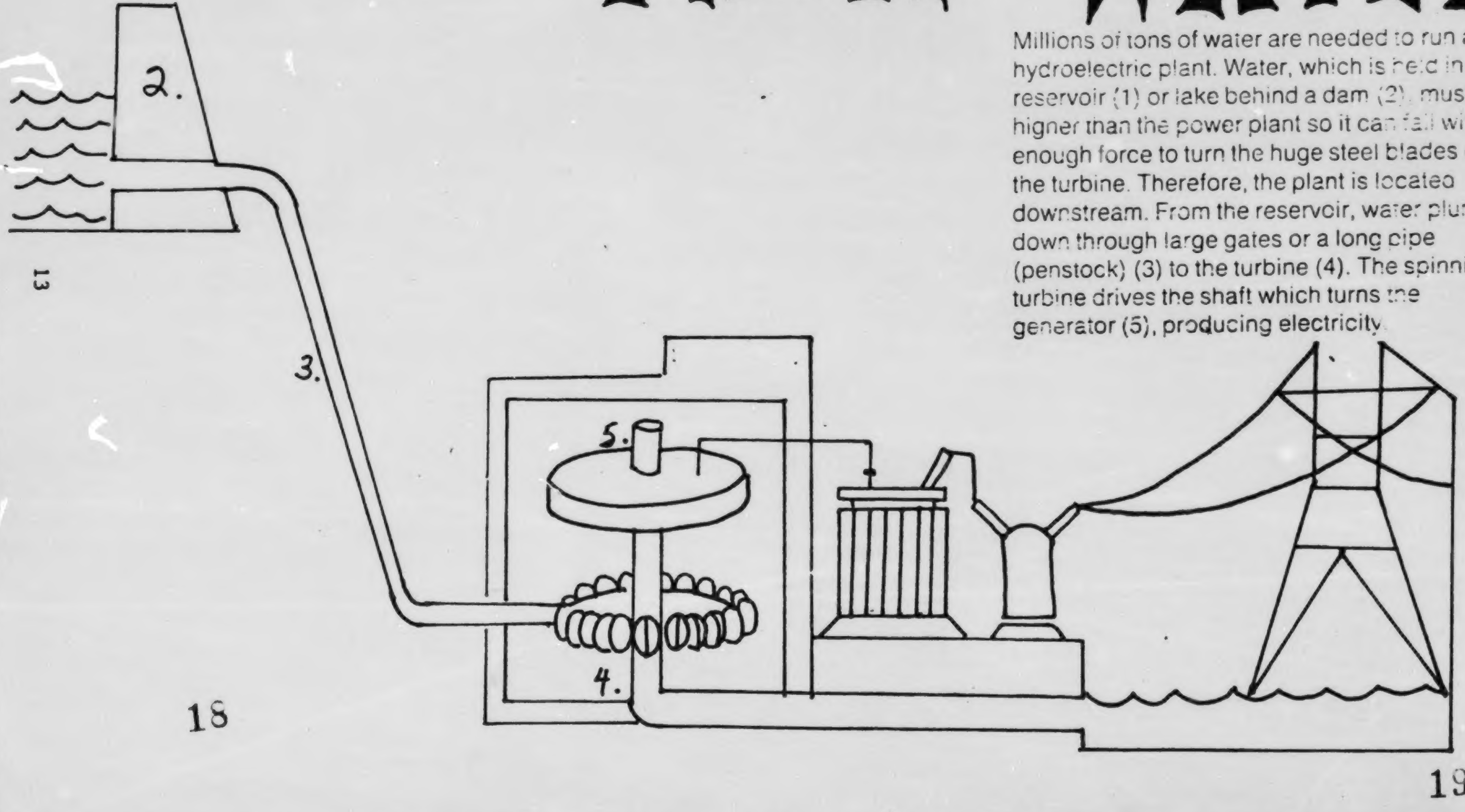
The energy in fossil fuels (stored in the form of chemical energy) comes from the energy stored in plants and animals long ago. Their energy came from the sun.

Ask children to *illustrate* and *label* the energy chain for any two of the examples of energy use the class contributed.

Evaluation: Do student illustrations identify and label immediate, intermediate and original source of energy? Can students identify and name two or more forms of energy present in their examples?

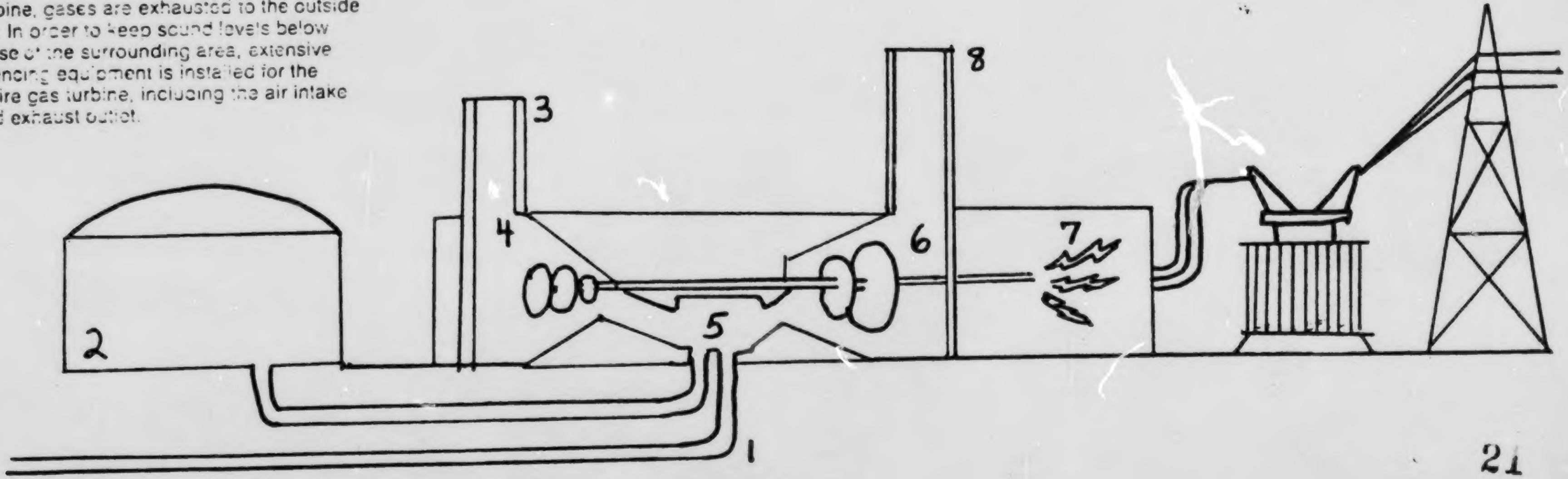
ELECTRICITY FROM WATER

Millions of tons of water are needed to run a hydroelectric plant. Water, which is held in a reservoir (1) or lake behind a dam (2), must be higher than the power plant so it can fall with enough force to turn the huge steel blades of the turbine. Therefore, the plant is located downstream. From the reservoir, water plunges down through large gates or a long pipe (penstock) (3) to the turbine (4). The spinning turbine drives the shaft which turns the generator (5), producing electricity.



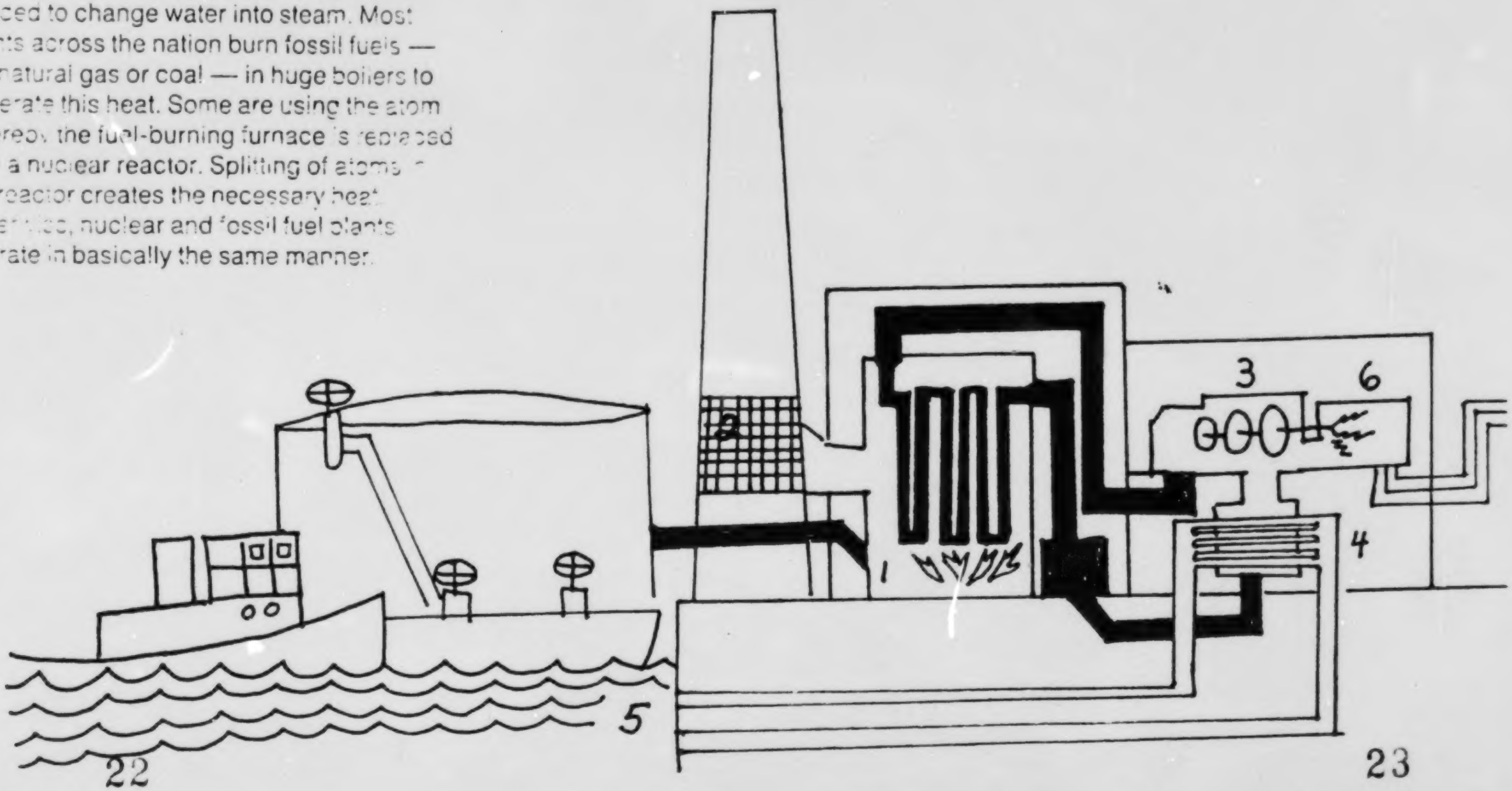
ELECTRICITY FROM GAS TURBINES

A gas turbine burns either natural gas supplied from a pipeline (1) (where available), or low-sulfur household type oil which is delivered by truck or barge and stored in a tank (2). Air, drawn from the outside (3), is compressed (4), and discharged into combustion chambers (5). Here, fuel is added, mixed with the air and burned. Burning process produces high-pressure combustion gases which flow to the turbine (8). Pressure of the gases rotates the turbine, which turns an electric generator (7). After passing through the turbine, gases are exhausted to the outside (9). In order to keep sound levels below those of the surrounding area, extensive silencing equipment is installed for the entire gas turbine, including the air intake and exhaust outlet.

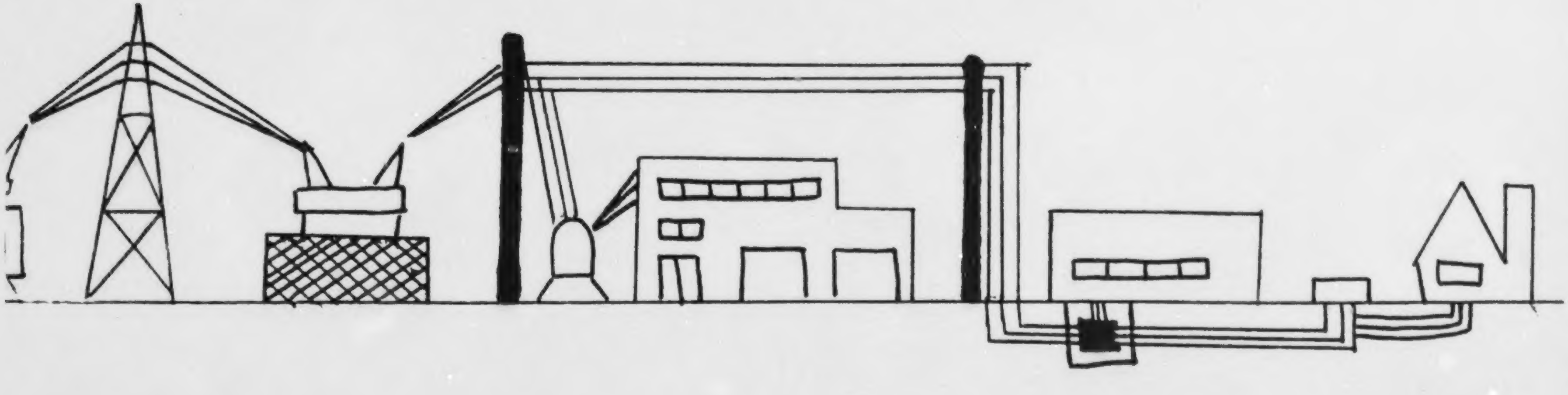


ELECTRICITY FROM FOSSIL FUELS

In steam-electric power plants, heat is needed to change water into steam. Most plants across the nation burn fossil fuels — oil, natural gas or coal — in huge boilers to generate this heat. Some are using the atom whereby the fuel-burning furnace is replaced with a nuclear reactor. Splitting of atoms in the reactor creates the necessary heat. Otherwise, nuclear and fossil fuel plants operate in basically the same manner.



Fuel is delivered to plant and stored in yard. Oil or finely powdered (pulverized) coal is blown into the boiler (1) where it burns, giving off intense heat. Water, circulating through miles of tubing in the boiler, absorbs heat from the fire and changes into steam. Ash resulting from the fuel burning in high-pressure boilers is removed from the stack gases by dust collectors (precipitators) (2). This permits clean gases to be released to the atmosphere, thereby reducing air pollution. Steam passes through the turbine (3) and into a condenser (4) where it is cooled and changed back into water as it flows over thousands of tubes. Water is then returned to boiler for reuse in the system. Water to condense steam is drawn from the body of water on which the plant is located (5), pumped through tubes in the condenser and returned to its original source. The turbine consists of a number of rows of blades which, much like spokes on a wheel, stem out from a shaft at the center. Steam acting against these blades, like wind on a windmill, causes the shaft to spin; its exact speed is controlled by a governor. Shaft turns the generator (6) which has two parts: a stationary part, coils of wire (stator); a rotating part, a magnet (rotor). Magnet rotates inside coils of wire. As the magnetic field moves at high speed past the coils of wire, alternating current is generated. Electricity then goes to a substation (7) outside the plant where transformers raise the voltage (electrical pressure) high enough to send the power many miles. Large cables (transmission lines) (8) suspended on steel poles or towers carry the current to substations (9). Here the voltage is lowered and electricity is fed into a distribution system (10). Smaller transformers provide proper voltages for industries, stores, homes and farms. After it reaches the customer, electricity goes through a meter which measures the amount being used.



ACTIVITY 2

Learning: We use electrical appliances to get useful forms of energy (heat energy, light energy, energy of motion or mechanical energy).

Materials: Fan, lamp, toaster, iron

Teacher Information: When we use electrical energy we usually convert it to another form. Electric lamps convert electrical energy to light energy. Motor driven appliances convert electrical energy to mechanical energy. We pay a price for this conversion in the form of extra, unwanted energy use.

For example, motor driven appliances become warm to the touch while being operated. The heat represents a loss of energy in that it is not intended nor is it put to use.

Incandescent light bulbs actually give out more heat than light. Anytime you heat up an object enough to make it glow (incandescence) you get more heat energy than light energy. This characterestic of heat and other forms of electromagnetic energy accompanying light from an incandescent object is called black body radiation. (This term is included for you and your further reading, not for your students.) Other examples of incandescence include the gas mantle in lanterns, a red-hot electric burner, and glowing coal. Note that fluorescent lighting works on another principle. These lights do not emit light as a result of incandescence. As a result they produce far less heat for the same amount of light than does an incandescent light.

Procedure: Using electrical appliances, identify and record the form of energy that does the intended work. Discuss other forms of energy which are present.

1. Using unplugged appliances (toaster, fan, lamp) have children recognize that electrical energy is needed to have these appliances work. (Electrical energy is a form of energy produced from energy sources such as fossil fuels, hydroelectric, or nuclear energy.)

2. Have children identify what each appliance does and the *form* of energy it uses to do its work (heat, light, motion).

3. List electrical equipment and appliances with which the children are familiar. Sort them by the form of energy that does the intended work. Chart the information.

Heat Energy	Light Energy	Mechanical Energy
curling iron	porch light	knife sharpener
hot plate	bathroom light	blender
toaster	bedroom lamp	fan

Evaluation: Ask: "What is similar about the energy form that mixes cake batter, moves hot air out of the room, and sharpens knives?" (All use energy in the form of motion.)

"In what form do the appliances that do this work get energy?" (electrical)

Similar questions might be asked about appliances that use heat or light energy to do their work.

ACTIVITY 3

Learning: Energy exists in many *forms*: heat energy, light energy, mechanical energy, nuclear energy, chemical energy, and electrical energy are all forms of energy.

Materials: Paper and pencil

Procedure: Tell children that heat, light, chemical, electrical, and mechanical energy are some of the forms in which we find energy.

Take a walk around and through the school buildings to look for evidence of these forms of energy in use. Record observations. Possibilities:

1. Traffic light--electrical and light
2. Electric typewriter being used--electrical and mechanical
3. Coffee maker or stove--electrical and heat
4. Fluorescent lighting--electrical and light
5. Sunshine--light and heat
6. Gas stove--chemical and heat
7. Cars moving--chemical and mechanical
8. Lawn mower--chemical and mechanical

Evaluation: Given a form of energy (heat, light, electrical, mechanical, chemical) can students identify an example for each?

ACTIVITY 4

Learning: Solar energy is required for survival of green plants.

Materials: Paper, pencil, a healthy green plant, paper clips, carbon paper

Teacher Information: All green plants require sunlight (solar energy) as a source of energy. Plants absorb nutrients in order to build cells while the sun provides the energy to put them together through photosynthesis. During the process of photosynthesis, the plant combines carbon dioxide and water and produces glucose, starches and oxygen which provide (some) ingredients and energy for production of other plant material.

Procedure: Fold a piece of carbon paper all the way around three big leaves. Use paper clips to hold the carbon paper in place. Write down the date, perhaps on the class calendar. Put the plant in a sunny place. Water the plant as usual. After five days take the paper off one leaf. Study the leaf. In what way does it look different from the other leaves on the plant? Keep the carbon paper off this leaf. After two more days take the carbon paper off another leaf. Study this leaf. How is it different from the other leaves on the plant? Leave the carbon paper on the third leaf until the leaf falls from the plant. Then study the fallen leaf. What happens to a green leaf when it is kept in the dark?

Evaluation: Ask students to identify the one change that was made for the three leaves. (Sunlight blocked by carbon paper. This is the manipulated variable.)

Ask students to identify what changed as a result of the leaf getting no sunlight. (Color change, eventual wilting and falling from the plant. This is the responding variable.)

Ask students to identify what variables were kept the same for all the leaves on the plant, uncovered and covered. (Warmth, water, nutrients from soil or fertilizer.)

Conclude that without light energy green plants cannot survive.

Extended Activity: List ways in which we use light energy from the sun in our daily lives.

List ways in which we use heat energy from the sun in our daily lives.

Discuss the changes we might experience if sunlight were reduced because of atmospheric conditions, man-made or natural.

ACTIVITY 5

Learning: Energy use, the energy form being observed, can be traced through the energy chain to its source.

Materials: Chalk, chalkboard

Procedure: Divide class into two teams. Ask: "What won't go (work, move) unless you put energy into it?" Record answers on chalkboard. Keep responses of each group separate.

Example:

Group A	Group B
car	fireplace
flashlight	trike
oven	dog
etc.	etc.

Ask: "From where does each get its energy?"

Teams will take turns telling about the energy chain of forms and sources about an item on the other team's list. Give two points for each step named (even though all steps may not have been identified).

Example:

Identify the energy chain that makes it possible for a car to move.

car → fuel (2) → plants (2) → sun (2) = 6 points

Identify the energy chain that results in warmth from a fireplace.

fireplace → wood (2) → sun (2) = 4 points

Evaluation: Conclude through discussion that the form of energy being used in an example can be traced through the energy chain to the sun.

OBJECTIVE 2: *Students will give examples of environmental concerns that are energy-related.*

ACTIVITY 6

Learning: There are many kinds of energy.

Materials: Books, magazines, newspapers, or picture files; "How Is Energy Used?" activity sheet (Appendix A-4); large (1" squares) graph paper for class graph.

Teacher Information: This activity will serve as a quick review to help students recall some of the many ways we use energy. We will then focus on environmental concerns that are energy-related. (When completing the student activity sheet, students may use forms and/or sources of energy.)

Procedure: Show the class a picture depicting the use of some form of energy. Ask the class to describe the form or source of energy being used in the picture. Use a few pictures as motivation, then distribute student activity sheets, "How Is Energy Used?". After students have completed the activity sheets, make a class graph of their results.

Evaluation: Have the class read and interpret the results of the class energy graph. What form or source of energy was used most in the pictures?

HOW IS ENERGY USED?

Look through newspapers, magazines, school books, library books, and find 10 different kinds of pictures. Write a description of your pictures and tell what form or source of energy is being used (gasoline energy, electrical energy, gas energy, solar energy, steam energy, nuclear energy). Could a picture show more than one energy type?

	Picture Description	Energy Being Used
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

Which type of energy did you see used most often? (Use picture results.)

____

Now add all your energy types to a class graph.

From the class graph, what did you find to be the most used form or source of energy? ________________________

ACTIVITY 7

Learning: There are environmental problems with all forms of energy.

Materials: Pie pan, matches, scrap paper (crumpled)

Procedure: Set the scene: "Pretend that we are a group of cave people. You live in a cave in a forest. Pretend that our classroom is the cave. It is winter."

Ask: "How would we as cave people keep warm?" (Responses will include animal skins, fire, go farther into the cave, etc. Focus on fire as one of man's earliest heat sources.) "How did cave people get this form of energy?" "What is the source of that form of energy?"

Ask: "What are some ways that, as cave people, we would use fire?" List these on the chalkboard. (cook food, keep warm, light cave, protection)

Say: "Let's pretend that we are sitting in our cave. I am going to build our fire in this little pan to represent our cave fire. Watch the fire very closely and see what happens." (Burn paper.) Ask: "What did you notice about our fire?" (It smelled bad, it smoked, it didn't last long.)

Ask: "Do you think the real cave families might have had some of the same problems with their fires?" Fire filled a real need for the cave people (it kept them warm, etc.), but there were problems (it was smelly, messy, smoky, dirty, etc.).

Point out that energy sources that we use today fill real needs but they, too, have problems.

Have students list situations in which fuels are burned today. Ask: "Are any of these causing environmental problems for San Diego County?"

Ask: "What do you think San Diego County's *worst* environmental problem is?" (List responses on board.) Ask "Why?" for each response, encouraging each student to substantiate his/her response with reasons.

Evaluation: Have each student select *one* problem from the list and write a letter to the County Health Department or an appropriate local agency asking what is being done about that problem.

> NOTE: Be sure to read each letter before sending it. Make sure they are in good taste and convey a genuine concern for San Diego's environment.

ACTIVITY 8

Learning: Our environment reflects our use of it.

Materials: A picture of some type of pollution involving land, air, or water and a picture of clean water, air or land.

Teacher Information: The purpose of this lesson is twofold: (1) to develop comparing and contrasting skills and (2) to have students obtain information from pictorial data. The two pictures should illustrate opposites and will thus enable students to see clearly the contrasts between the two. The activity will provide students with data for group discussion.

Procedure: Have students examine one picture for a minute or so without any comments.

Say: "After looking at this picture, what is one thing you notice?" Encourage *one* response from a student rather than one student naming a dozen things. In this way, more students will participate.

After several students have responded and most of the items have been named, have students examine the other picture without comment.

Ask: "What do you see in this picture?" Again encourage one observation per student and strive for wide participation.

After several responses, say, "Now, looking at both these pictures, how are they alike?" (They both depict a farm, they both have a fence, they both have buildings, they both have water, etc.)

Say: "Now look at the two pictures and think of how they are different." (One is clean, the other dirty; one is well cared for, the other run down; etc.)

Ask: "What do you think has caused the situation in this picture?" (When you get a response, ask, "Why would that cause this condition?") Ask for other things that might cause this condition.

Ask students if they have ever seen an area that resembles this. Describe it.

Ask if they have ever seen an area that resembles the other picture. Describe it.

Ask: "Which of these places would you rather be in? Why?"

Evaluation: Repeat the process of comparing and contrasting using two other pictures.

ACTIVITY 9

Learning:	A clean environment depends on people.
Materials:	Dictionaries, "What Does It Mean?" activity sheet (Appendix A-5)
Teacher Information:	The purpose of this activity is twofold. First, the dictionary is introduced as a resource for finding the meaning of words; second, the words used in the activity are selected to develop vocabulary (spoken as well as reading and written) necessary for the study of energy and the environment.
Procedure:	Tell students that as we study energy and the environment there will be new words for which we need to know meanings. One source, of course, that we can use to find this necessary information is the dictionary. Ask students to name everything they know about dictionaries. List these on the board. (arranged alphabetically, gives the meanings of words, tells how to pronounce words, etc.) Using the classroom dictionaries have children use guide words to find several words as practice. (environment, protect, recycle, collect). After each word is located, look at the pronunciation and the meaning of the word. Tell students that they are going to use the dictionary to look up some words, and then use these words to make sure they understand the meanings. Distribute the "What Does It Mean?" activity sheet and make sure students understand what they are to do.
Evaluation:	Have students complete the activity sheet, "What Does It Mean?". Have students share their sentences.

WHAT DOES IT MEAN?

Find these words in the dictionary and write the meaning of each word.

1. resource ______________________________
2. fuel ______________________________
3. pollute ______________________________
4. values ______________________________
5. conservation ______________________________
6. environmentalist ______________________________
7. waste ______________________________

Put the words in alphabetical order:

1. ____________________
2. ____________________
3. ____________________
4. ____________________
5. ____________________
6. ____________________
7. ____________________

Write a sentence using as many of the words as you can:

____

____

____

ACTIVITY 10

Learning: We need to become aware of words that are energy- and environment-related.

Materials: "Words, Words, Words" activity sheet (Appendix A-6); dictionaries; publications (books, pamphlets, etc.) related to energy and environment (see page 3 for sources); graph paper.

Teacher Information: After compiling individual lists of words, students will select 10 words which they will alphabetize, look up the definition, and use in a sentence. The class will do a graph which records the frequency of the words used.

Procedure: Have each student list 15 words related to energy or environment. Encourage skimming of printed materials you have made available. Compile a master list on the chalkboard. Have students select 10 of these words for use on the activity sheet, "Words, Words, Words."

When students have completed their worksheets, record the frequency of the words used on a graph. As you tabulate the frequency, ask students to classify the words as energy- or environment-related.

Evaluation: Have students identify words which they have learned as a result of this activity.

WORDS, WORDS, WORDS

Select 10 energy-related or environment-related words. Look up the definitions for your words. Write your words in the blank spaces that follow:

__________ __________ __________ __________ __________

__________ __________ __________ __________ __________

In the spaces below, put all 10 words from your list in alphabetical order, and write a sentence of your own for each word you have selected. (Be sure you read the word meaning.)

1. __________ ______________________________
2. __________ ______________________________
3. __________ ______________________________
4. __________ ______________________________
5. __________ ______________________________
6. __________ ______________________________
7. __________ ______________________________
8. __________ ______________________________
9. __________ ______________________________
10. __________ ______________________________

Select one of your words and find out how many other people in your classroom used the same word. Share your paper with your teacher for a class activity.

ACTIVITY 11

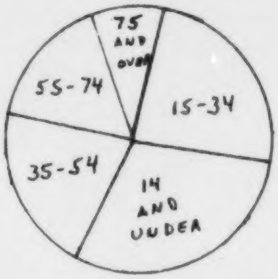
Learning: Larger city populations add to environmental concerns.

Materials: "Can You Read a Pie?" activity sheet (Appendix A-7)

Teacher Information: This activity is twofold. It will introduce students to simple pie graphs and it will, at the same time, give them data that will be helpful in understanding the concepts in this unit.

Procedure: Draw a pie graph on the board as an example.

UNITED STATES
POPULATION
BY AGE

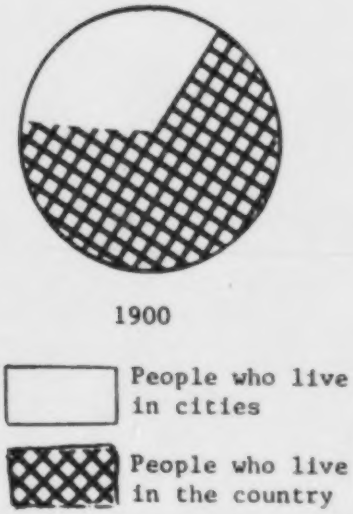


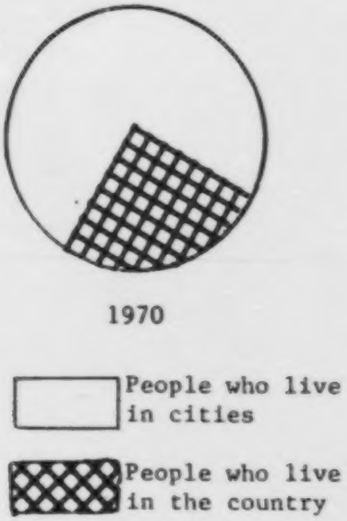
Explain that this is called a pie graph. It looks like a pie that has been cut into pieces. A pie graph can tell how much of one thing is in a whole. In this example the whole pie stands for the population of the United States. Point out that the pie is not cut into equal parts.

Ask: "Why do you think the pie is not divided into equal parts?"
"Which is your age group?"
"Which is the biggest 'slice' of the pie?"
"Which is the smallest?"

Evaluation: Have students complete the "Can You Read a Pie?" activity sheet. Discuss items 3-6 especially after completion of the activity sheet.

CAN YOU READ A PIE?





1. Look at the two graphs. What kind of information do they give you?

   ____

2. Use the graphs to answer these questions:

   In 1900 did more people live in cities or in the country?

   ____

   In 1970 did more people live in cities or in the country?

   ____

3. How could this cause problems for cities?

   ____

4. What problems do you think a city would have that a farm would not?

   ____

5. Why do you think people in the United States have moved into cities from farms? ______________________________

   ____

ACTIVITY 12

Learning: The use of energy sources causes pollution.

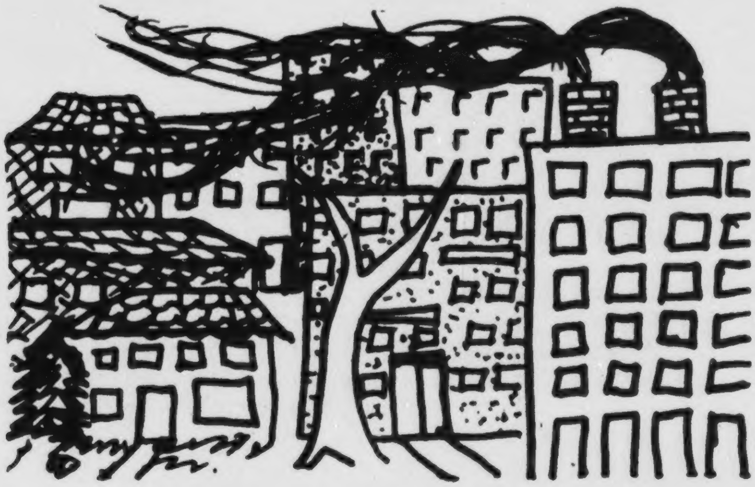
Materials: Light blue construction paper 12" x 18", assorted colors of scrap construction paper, scissors, paste, black crayon

Procedure: Say: "Cut some houses and other buildings from construction paper scraps. Make trees, grass, etc. Make one of the buildings much larger than the others. Put chimneys on it. Paste all of the buildings down on your paper." Ask: "What do you see? Do you see a town with nice buildings and a clear sky?"

Say: "Now take your black crayon and make smoke coming out of the chimneys of the largest building. Use the side of your black crayon lightly to make the sky gray. Now gray your buildings lightly with the black crayon." Ask: "How does your town look now? Does the town you live in look like this? Would you like to live in a town that looks like this? Why or why not?"

Say: "Some of the major cities in the world look like this. Could this have been prevented?"

Ask: "Can anything be done now to improve this town? What could be harmed by this pollution other than the buildings? What kind of fuel do you think is being used in this town? Do all sources of fuel cause pollution?"



Evaluation: Ask: "Did you like your picture best before or after you added the black crayon? Why?"

ACTIVITY 13

Learning: Coal is a natural resource.

Materials: "The Story of Coal" information sheet (Appendix A-8)

Procedure: Explain to students that as we study about energy and our environment we will be doing some reading and will often need to tell in a few words what was said. This is called "summarizing."

Say: "We are going to look at a story about the use of coal and learn to summarize."

Have students follow as you read aloud the first paragraph of the information sheet, "The Story of Coal."

Say: "I have just read three sentences. Let's see if we can summarize that in one sentence."

Ask for a volunteer to tell in his/her own words what the paragraph said.

Allow several children to respond. Help them see that there are many ways to say it, but each person condensed (shortened) what the paragraph said. They *summarized* the paragraph.

Repeat the procedure for the next two paragraphs.

Say: "Now we are going to read a longer paragraph. Listen carefully as it is read."

Have the paragraph read. Have students think of what is said. Then have them skim the paragraph again and think of how to say it in fewer words.

Again ask for someone to tell the class in his/her own words what the paragraph said.

Allow several children to summarize the paragraph.

Evaluation: Have students write a summary of the story of coal in their own words and then illustrate it.

THE STORY OF COAL

A long time ago there were many trees and big plants on the earth. When they died they fell to the ground. Millions of years went by. The trees and plants turned into coal.

Coal has not always been used by people. Farmers saw it when they worked in their fields. Sometimes hunters found pieces of the black rock on the ground. No one thought it could be used for anything.

Then people found uses for coal. People dug down deep into the earth for coal. They began to burn coal. It gave off heat. It could turn iron into steel. It could make a room warm. It could cook food.

Some railroads began to carry coal all over the country. The coal was used in homes and in factories. It was used to make the trains move. The car behind the train engine was filled with coal. A railroad worker shoveled coal into a firebox. The firebox heated water. The hot water made steam. The steam made the train move. People had learned that coal could be used to make steam power and heat. Coal became an important natural resource.

ACTIVITY 14

Learning:	Groups work to save our environment.
Materials:	"Environmentalists" information sheet, Appendix A-9; "The Main Thing" activity sheet (Appendix A-10).
Teacher Information:	Each student will need a copy of the information sheet and a copy of the activity sheet. This activity is twofold. It will introduce the skill of finding the main idea in a passage *as well as* providing data that will assist the study of energy and the environment.
Procedure:	Explain to students that the *main idea* (write on board) of any passage is the "message" of that reading. It is the point that the author wants to get across. Sometimes it is stated in the first sentence of the reading and everything else explains it or supports it. Sometimes you must read the entire passage and then ask yourself, "What is the main thing the author was saying?" Have students read the information sheet, "Environmentalists." Have students think about the "message" the author was trying to convey in the passage on this page. Ask for volunteers to tell the class what they think the *main idea* of this passage is. Elicit several responses. Be sure the ideas are *brief* and in the student's own words.
Evaluation:	Distribute "The Main Thing" activity sheet, Appendix A-10. Have students complete the activity sheet. Discuss the activity sheet after it has been completed, especially number 8.

ENVIRONMENTALISTS

People who work to protect America's natural beauty are called environmentalists. They care about our parks and our rivers and our streams. They want to keep parks clean and beautiful so all people can enjoy the out-of-doors.

Environmentalists sometimes start clubs so they can work together. One such club is the Sierra Club. Many different kinds of people belong to the Sierra Club. Boys and girls and men and women from all parts of the country belong to the Sierra Club.

These people work to help everyone see how important it is to save the natural beauty that we have. They work in Washington, D.C., to tell lawmakers about the laws that are needed to help save forests, parks, fields, streams and wild animals. The club hopes these laws will be made so you will have beautiful places to go to when you are grown.

THE MAIN THING

1. What are environmentalists?

____

____

2. What does the first paragraph say? (In your own words, summarize it in *one* sentence.)

____

____

3. What is the Sierra Club?

____

____

4. Why would someone belong to the Sierra Club?

____

____

5. What does the second paragraph say? (In your own words, summarize it in *one* sentence.)

____

____

6. What does the third paragraph say? (In your own words, summarize it in *one* sentence.)

____

____

7. Look at what you have written and find the *main idea* of this reading. Write it in your own words.

____

____

8. Would you want to belong to an environmental club? ______________

Why? ______________________________________

____

OBJECTIVE 3: *Students will give examples of activities that involve energy consumption as well as economic cost. (The real cost of anything is what you give up to get it.)*

ACTIVITY 15

Learning: Different physical activities take differing amounts of energy.

Materials: A social studies textbook, "Human Energy" activity sheet (Appendix A-11)

Procedure: Take the children out to the playground and have them do a brief, strenuous activity (run around the blacktop, calisthenics). Children should feel tired at the end of the activity. Go immediately and directly to the classroom at the end of the activity.

Ask the children how they feel right now. Ask: "Why? What did your body use as you exercised? (energy) What does your body need in order to exercise? Where does your body get energy?" (food)

Say: "The exercise we just did *cost you energy*. You got the energy from food you ate. The food was your fuel. The food was your source of energy."

Ask: "Where does your family get the fuel you use? (from the store or garden) Is the fuel free?"

Say: "In doing an activity or in playing you have *two* costs: (1) the energy you use and (2) the cost of the fuel that gave you energy."

Evaluation: Distribute "Human Energy" activity sheet, Appendix A-11.

Have students complete the activity sheet, and then discuss the high energy cost examples and the low energy cost examples. Point out that activity that requires high energy would require more fuel (food) and would therefore require higher economic costs. Use this parallel for children: A football player on a pro team who is very active would need more fuel than an ex-football player who is no longer playing. Therefore, the football player on the pro team would have to spend more money on food than the ex-football player who is no longer playing. Have children give other examples of high and low energy cost activities and their relative economic costs.

HUMAN ENERGY

Look through a textbook and find at least 10 pictures with people. Write a description of the activities that the people are doing in each picture. Then check whether the people would be using up a high level or a low level of energy.

	Page Number	Picture Description	Energy Cost High	Low
1.	______	______________________________	______	______
2.	______	______________________________	______	______
3.	______	______________________________	______	______
4.	______	______________________________	______	______
5.	______	______________________________	______	______
6.	______	______________________________	______	______
7.	______	______________________________	______	______
8.	______	______________________________	______	______
9.	______	______________________________	______	______
10.	______	______________________________	______	______

If this paper makes you think hard (which means you are working your brain hard), then you are using up energy. What will you do to replace the used-up energy? How much will it cost? Draw your answers below.

ACTIVITY 16

Learning: The cost of using a non-renewable natural resource (oil) is that it will someday be gone.

Materials: Reference books, encyclopedias; "Research Guide" activity sheet (Appendix A-12).

Teacher Information: The United States is the biggest user of oil in the world. Although we have only 6% of the world population, we use 33% of the world's energy. Discovery of oil deposits in the United States has not kept up with our appetite for it, thus we are becoming more and more dependent upon imported oil.

In order for students to understand the cost of our uncontrolled use of a limited natural resource, they need to understand that oil is used for many different things, where it comes from, how it is converted, and how we get it. A small group of students could be assigned this lesson as a research project to be shared with the entire class.

Procedure: Distribute the available books among the students.

Each child will research *one* question.

1. What is oil? How did it get into the ground?
2. Where are the large deposits of oil found in the world today?
3. How do we get oil out of the ground?
4. How does oil become gasoline?
5. What are some uses of oil?

Use the activity sheet, "Research Guide," Appendix A-12, as a format to assist students in the research. Encourge them to use as many visuals as possible as they present their material to the class. (Use large sheets of butcher paper for diagrams, drawings, charts, etc.)

RESEARCH GUIDE

1. What am I trying to find out? Write it: ______________________________

____

____

2. Use the index of books to find page numbers that will give you information. Write them:

____

3. Read the pages. Summarize each page.

____

____

____

____

____

____

____

____

____

4. What is the main idea of what you read?

____

____

5. If there is a picture or a chart that will help explain the information, draw it on a large piece of paper.

6. Think of how you are going to present your ideas to the class so that they will understand what you found.

ACTIVITY 17

Learning: The cost of using a nonrenewable resource (coal) is that it will someday be gone.

Materials: Encyclopedias, "Research Guide" activity sheet (Appendix A-12)

Teacher Information: People began to use coal about 150 years ago for steam power and heat. Not many generations ago, coal was used more than any other fossil fuel in this country. Then oil became the main source of energy to make our country "go."

We continue to consume energy at a faster and faster rate. Our annual energy consumption has doubled since 1950. The recent oil crisis has led to the resurgence of coal as a fuel, especially in power-generating facilities.

Students need to understand that, while coal is more plentiful than oil, there are many environmental problems connected with extracting it.

This activity could be an assignment for a small group as a research project to be shared with the entire class.

Procedure: Distribute the available books among the students. Each child should research one question.

1. What is coal? How did it get into the ground?
2. Where are the large deposits of coal found in the United States?
3. How do we get coal out of the ground?
4. What are some problems with using coal?
5. What are some things that are made from coal?

Use the activity sheet, "Research Guide," Appendix A-12, as a format to assist students in the research. Encourage them to use as many visuals as possible as they present their material to the class. (Use large sheets of butcher paper for diagrams, drawings, charts, etc.)

RESEARCH GUIDE

1. What am I trying to find out? Write it:

2. Use the index of books to find page numbers that will give you information. Write them:

3. Read the pages. Summarize each page.

4. What is the main idea of what you read?

5. If there is a picture or a chart that will help explain the information, draw it on a large piece of paper.

6. Think of how you are going to present your ideas to the class so that they will understand what you found.

ACTIVITY 18

Learning: Some cars use less gasoline--a valuable natural resource.

Materials: Magazines, "Miles per Gallon Chart" (Appendix A-13)

Teacher Information: The end product of this activity will be a bulletin board. It could be done by a small group of students and used to reinforce the concepts in Activity 13.

Procedure: Have students collect pictures of automobiles from magazines. Have them use the "Miles per Gallon Chart" to find the gasoline mileage for that particular make of car.

Arrange the pictures with the corresponding gas mileage on a bulletin board. Encourage students to be creative in displaying the pictures.

Caption the bulletin board. (Perhaps "What Is the Real Cost?")

Evaluation: Using the bulletin board as data, have students find:

the car that gets the best gas mileage
the car that gets the worst gas mileage
the number of cars that get over 20 miles per gallon
the number of cars that get less than 20 miles per gallon
which gets better gas mileage--a small car or a large car?
which would cost less in energy consumption?

Ask: "What is the real cost of automobiles?"

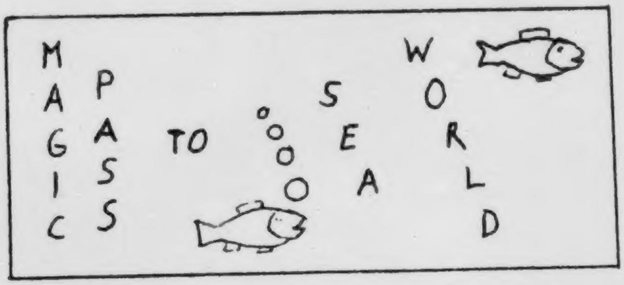
Model	Manufacturer	MPG
Chevette	GM-Chevrolet	36
Civic CVCC	Honda	44
Corolla Sedan	Toyota	32
Datsun B-210	Nissan	42
Datsun 200SX	Nissan	26
Accord CVCC	Honda	42
Celica GT	Toyota	26
Rabbit	Volkswagen	34
Fiat 128	Fiat	27
VW Station Wagon	Volkswagen	28
Opel (Isuzu)	Isuzu	27
Vega	GM-Chevrolet	28
Dodge Colt	Mitsubishi	35
Pinto	Ford	30
Mazda GLC	Toyo Kogyo	38
Mustang II	Ford	26
Datsun 280Z	Nissan	21
Volvo 244	Volvo	22
Gremlin	American Motors	23
Maverick	Ford	24
Volare	Chrysler-Plymouth	20
Nova	GM-Chevrolet	22
LTD II	Ford	17
GTO	GM-Pontiac	17
Trans Am	GM-Pontiac	17
Matador	American Motors	15
Cutlass Supreme	GM-Oldsmobile	18
Cougar	Ford	16
Ford	Ford	15
Buick Electra 225	GM-Buick	18
Plymouth	Chrysler-Plymouth	15
Silver Shadow	Rolls Royce	12
Chrysler	Chrysler-Plymouth	13
Bonneville	GM-Pontiac	17
Eldorado	GM-Cadillac	14
Buick Wagon	GM-Buick	18
Ford Wagon	Ford	13
Chrysler Wagon	Chrysler-Plymouth	12
Continental Mark V	Ford	13
Toronado	GM-Oldsmobile	15
Grand Prix	GM-Pontiac	17
Thunderbird	Ford	17
Mercedes 280 SE	Daimler-Benz	16
Seville	GM-Cadillac	16
Chevy Van V-8	GM-Chevrolet	18
Dodge Van V-8	Chrysler-Dodge	16
Ford Van V-8	Ford	16
VW Bus	Volkswagen	23

January 1977 Gas Mileage from EPA City/Highway Test Cycle. Source: "1977 Gas Mileage Guide for New Car Buyers," U.S. Environmental Protection Agency, January 1977 (Second Edition) Fuel Economy, Pueblo, Colorado 81009.

ACTIVITY 19

Learning: We need to know the real cost of what we want.

Materials: Magic passes made from 12" x 18" manila paper to Disneyland, Magic Mountain, Sea World, a camping trip, an airplane trip to see grandmother, a trip to Farrell's with all the ice cream you want, or the Wild Animal Park. Example:



Teacher Information: It is important that children begin to recognize that "there is no such thing as a free lunch." We must always give up something in order to get those things that we want. Children need to relate this to their own lives first and then to the more complex social issues. The deeper values implications need to be discussed as you proceed with this objective.

Procedure: Tape all the Magic Passes to the chalkboard. Tell the class that they may choose three of these passes and that the pass will *take* them to those places free of charge.

Ask the class to write their three choices on a piece of paper. Share these with the rest of the class.

Ask the class to circle the *one* trip on their list that they would like if they could have only *one* Magic Pass. Ask them to share this choice and tell why they chose that one.

Ask: "Was that an easy choice for you to make? Why? Did you want to go to any of those other places? What did you give up when I asked you to choose just one place? Was that hard?"

Say: "The cost of getting the one Magic Pass was giving up the other passes."

Ask children to think of other times when they have had to *give up* something in order to *get* something. Allow several children to share. Each time have the child define what was *given up* and point out that *that* was the real cost of getting what you wanted.

Tell students that you are going to read to them about something that people in this country *want* and that then they will take a look at what they are giving up to get it.

Read:

> Americans like cars! They like cars for getting to and from work. They like cars for going shopping. They like cars for going to ball games and to parks. They like cars for going on trips. They like cars for seeing beautiful places in our country.
>
> Many Americans like to drive big cars. They like big cars because they can hold the whole family with plenty of room for everyone. They like big cars because they are comfortable.
>
> Some people like small sports cars. They don't hold many people, but they go fast. Some people like cars that are air-conditioned so they will be cool in hot weather.
>
> There are millions and millions of cars in America. Each year there are more cars and more people who want to drive.

Discuss what it is that the American people want. Further discuss what people want in a car.

Point out that all cars require gasoline, and gasoline comes from a natural resource. The cost of our use of automobiles is that we are using up a natural resource.

Evaluation: Have students design a car that could run on something that is renewable so the cost to our limited natural resources would not be so high. Encourage imagination and creativity.

Or have students list ways that gasoline could be conserved.

ACTIVITY 20

Learning: People make individual choices about the real cost of depleting natural resources.

Teacher Information: The people of the United States have always valued individual freedom. This activity points out that, while we are free to use our natural resources (particularly oil) to do the things we *individually* want, natural resources belong to *all* people of the world. We need to look at our consumption of these natural resources and seek alternatives to using more than our share of resources that are dwindling.

Procedure: Tell children that, since natural resources like oil (from which we get gasoline) can be used up, we need to make some choices about how they are used.

Write these questions on the board:

1. Why do you think some countries make small cars?
2. What is a public transportation system?
3. How would buses and subways save gasoline?
4. How would a limited amount of gasoline for each person change the kinds of cars people drive?
5. What would Americans have to give up?

Discuss the questions.

Then ask: "Do you think that we should continue to use as much gas as we want? Whom does the oil that is used to make gasoline belong to?" (While it is deposited in specific parts of the world, the world's resources belong to the world.)

Point out to children that the people of the United States use more oil than is produced here. Ask: "What do you think we should do about using more than our share of this natural resource?"

Say: "If the freedom to drive the kind of car we want and to use as much gasoline as we want is important to us, what is the *real* cost of that freedom?" (What are we giving up to get it?) "Or, if we really want to conserve the world's oil supply, what will the *real* cost of that be?" (What do we give up to get it?)

Evaluation: Tell students that certainly there are valid arguments on both sides of this issue, and that no one knows for sure what is going to happen in the future.

Have them write a story explaining what they think will happen.

ACTIVITY 21

Learning: Driving an automobile costs fuel and money.

Materials: San Diego County Map (Appendix A-14)

Teacher Information: Every time we use an automobile we are using up a portion of a nonrenewable resource--gasoline. This is an energy cost as well as an economic cost. (The six-block distance for this lesson was chosen specifically because it would be far enough to drive but close enough to be walked.)

Procedure: Tell the following make-believe story: "You and your mother have decided to bake peanut butter cookies. Mother discovers she's all out of peanut butter. The store is six blocks away. After talking about it, you and your mother decide that there are three ways you could get to the store." (List these on the chalkboard.)

1. Drive the car.
2. Ride your bikes.
3. Walk.

Draw the following chart on the chalkboard.

	Money Cost	Fuel Cost (kind of fuel)
Walk		
Ride Bikes		
Drive Car		

Have class discuss the money and fuel cost for each mode of transportation. List the costs on the chart.

Ask:

"Which way do you *usually* go to the store?"
"Looking at the chart, which way would cost less in money and fuel?"
"Which way do you think is best? Why?"
"Which way would *you* go to the store? Why?"

Read:

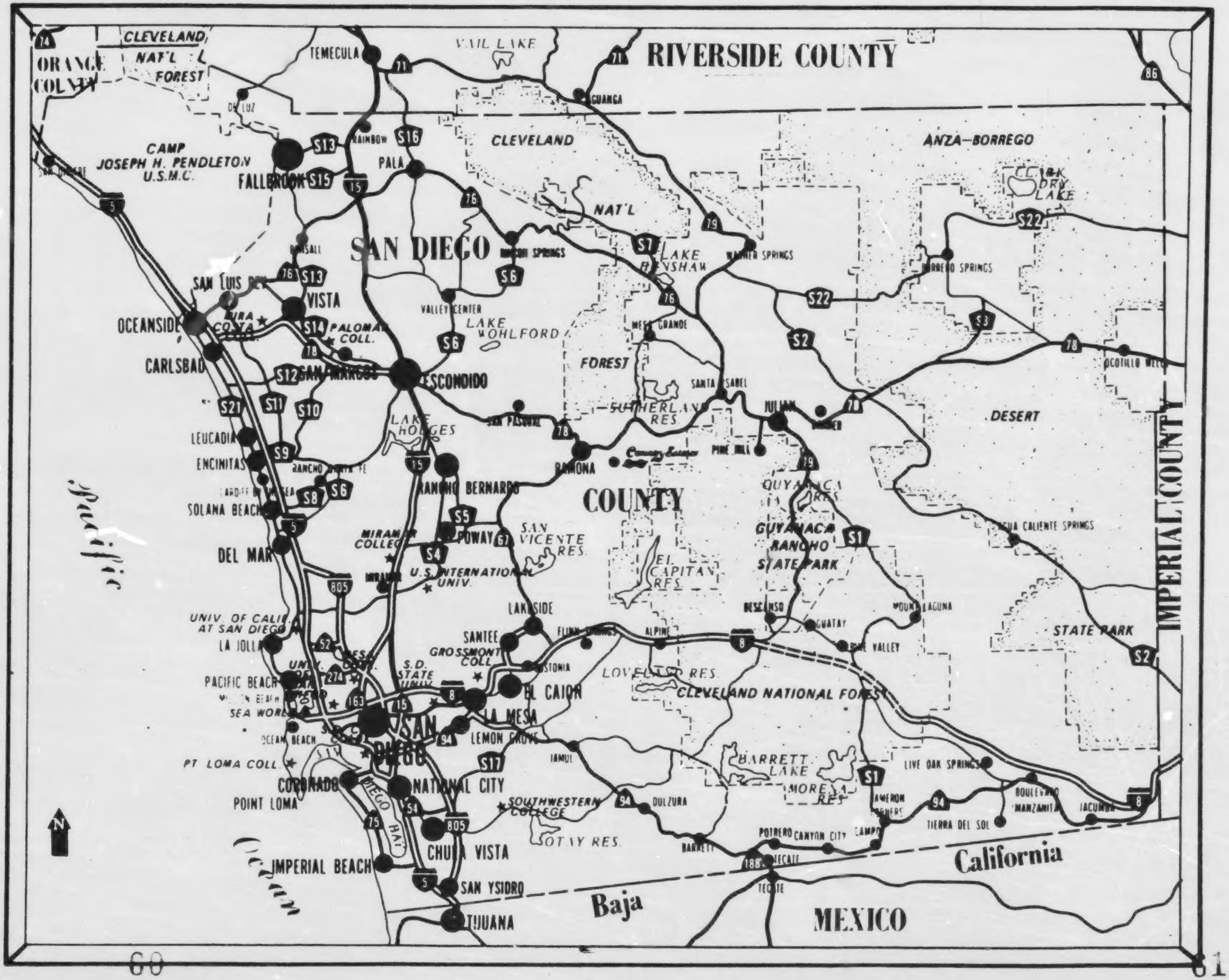
> San Francisco has a way to move people around quickly. It is called BART (Bay Area Rapid Transit). The trains run between San Francisco and the suburbs around San Francisco Bay. In the city the trains run in tunnels under the ground. Outside the city the trains run above the ground. During the rush hour trains leave the city every few minutes. This helps people get where they want to go quickly. It also keeps many people from driving their cars into the city.

Invite students to share what they know about BART in San Francisco. Then ask: "Why would a big city like San Francisco want many people to use BART?"

Evaluation: Discuss the public transportation system in San Diego County. Ask, "How would a system like BART help save energy in San Diego County?" Suggest that we look at San Diego County and plan a rapid transit system. Using the San Diego County map (Appendix A-14), have children work in small groups to plan a San Diego County rapid transit system. Have them consider:

- The routes (limit to four)
- How the system will accomodate:
    - Different communities
    - Business areas
    - Industrial areas
    - Housing areas
- Where it will go--above ground, underground, under water
- Where the transfer stations will be
- A name for the system

After each small group has developed its system, have them present it to the class, explaining why they planned it the way they did and how it will help with energy consumption in San Diego County.


RIVERSIDE COUNTY
ORANGE COUNTY
CLEVELAND NAT'L FOREST
VAIL LAKE
TEMECULA
AGUANGA
DE LUZ
CAMP JOSEPH H. PENDLETON U.S.M.C.
SAN ONOFRE
FALLBROOK
RAINBOW
PALA
CLEVELAND
NAT'L
FOREST
ANZA-BORREGO
CLARK DRY LAKE
SAN DIEGO
COUNTY
RINCON SPRINGS
BONSALL
LAKE HENSHAW
WARNER SPRINGS
BORREGO SPRINGS
SAN LUIS REY
OCEANSIDE
MIRA COSTA COLL.
VISTA
PALOMAR COLL.
VALLEY CENTER
LAKE WOHLFORD
MESA GRANDE
CARLSBAD
SAN MARCOS
ESCONDIDO
SANTA ISABEL
JULIAN
BANNER
OCOTILLO WELLS
DESERT
SUTHERLAND RES.
LAKE HODGES
SAN PASQUAL
LEUCADIA
ENCINITAS
RANCHO SANTA FE
CARDIFF BY THE SEA
SOLANA BEACH
RAMONA
PINE HILLS
CUYAMACA RES.
CUYAMACA RANCHO STATE PARK
RANCHO BERNARDO
POWAY
SAN VICENTE RES.
EL CAPITAN RES.
AGUA CALIENTE SPRINGS
DEL MAR
MIRAMAR COLLEGE
MIRAMAR
U.S. INTERNATIONAL UNIV.
Pacific
Ocean
UNIV. OF CALIF. AT SAN DIEGO
LA JOLLA
LAKESIDE
FLINN SPRINGS
ALPINE
DESCANSO
GUATAY
PINE VALLEY
MOUNT LAGUNA
STATE PARK
IMPERIAL COUNTY
SANTEE
GROSSMONT COLL.
PACIFIC BEACH
UNIV. OF S.D.
MISSION BEACH
SEA WORLD
S.D. STATE UNIV.
MESA COLL.
EL CAJON
LA MESA
LOVELAND RES.
CLEVELAND NATIONAL FOREST
OCEAN BEACH
SAN DIEGO
LEMON GROVE
JAMUL
BARRETT LAKE
MORENA RES.
LIVE OAK SPRINGS
PT LOMA COLL.
CORONADO
POINT LOMA
NATIONAL CITY
SOUTHWESTERN COLLEGE
OTAY RES.
DULZURA
CAMERON CORNERS
BOULEVARD
MANZANITA
JACUMBA
TIERRA DEL SOL
CAMPO
CHULA VISTA
IMPERIAL BEACH
SAN YSIDRO
BARRETT
POTRERO
CANYON CITY
TECATE
California
Baja
MEXICO
TIJUANA
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ACTIVITY 22

Learning: Every product involves an energy cost.

Materials: Recipe for cookies; some man-made objects such as ball bat, baseball glove, baton, a book, a deck of cards, a pair of jeans (try to stay away from synthetics).

Teacher Information: Children's awareness of the number of times energy is used and the kinds of energy used in the manufacture of everyday articles should be heightened by this exercise. Children should be encouraged and stimulated to be as complete as their experience and knowledge permit. However, awareness is more important than accuracy.

See *World* (published by National Geographic) magazine for articles describing and illustrating the manufacture of things: July 1977--bubble gum, December 1976--candy canes, September 1976--balloons, as well as recent issues.

Procedure: Look at the list of ingredients for a cookie recipe or a recipe children have used in the classroom.

Instead of ingredient recipes, write *energy* recipes. Choose a manufactured article like a pencil and list the kinds of energy that went into making it. (Sun's energy makes the tree grow; fuel energy powers the saw that cuts down the tree; fuel to power the truck which moves the logs; water energy moves it down a river, etc.)

Evaluation: After composing a class recipe, have the children select an object from an assortment and write an *energy* recipe. Collect the energy recipes in a book to be included in the classroom library.

ACTIVITY 23

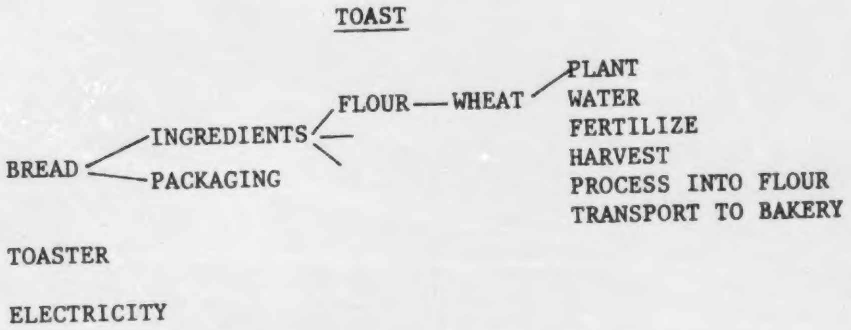
Learning: It takes energy to make things.

Materials: Toaster, one piece of bread, manila paper 12" x 18", crayons, pencils.

Procedure: Tell the children that you are going to do something very simple, but they need to watch closely. Put a piece of bread into the toaster and wait for it to pop up.

When the toast is ready, go to the chalkboard and in the center put the word "toast." Ask the children to name all the things it took to make the toast (toaster, bread, electricity). Make a chain of things it took to make toast and *focus on the energy*. Discuss the energy necessary to accomplish what at first glance appears to be a simple procedure.

Example of one component:


TOAST
BREAD
INGREDIENTS
PACKAGING
FLOUR
WHEAT
PLANT
WATER
FERTILIZE
HARVEST
PROCESS INTO FLOUR
TRANSPORT TO BAKERY
TOASTER
ELECTRICITY

(Each of the ingredients should be charted as well as the energy chain for the packaging of bread. Then chart the energy chain for the toaster and electricity.)

Evaluation: Have the children make their own energy chain using one of the examples below.

1. A cup of coffee
2. A glass of milk
3. A glass of orange juice
4. A salad
5. A fried egg

Write the energy chain, then illustrate it. Share it with the class.

ACTIVITY 24

Learning: As we use materials, we are using the energy required to produce the product.

Materials: Paper 9" x 12", crayons, masking tape, scissors

Procedure: Say to the class:

> "This sheet of paper costs one cent. If you were to throw this paper away, would you only be throwing away one cent? No, you would also be throwing away all the energy that was used to make this paper. Let's see if we can discover all of the different kinds of energy that went into making this paper."

It will probably be easiest to work backwards through this process with the children. Now ask:

"How did you get this paper?"
"How did it get to our classroom?"
"How did it get to the supply room?"
"How did it get to the school?" Etc.

List each response on the chalkboard or on a chart.

Evaluation: Assign one or more children to draw each of the steps in making paper from the tree seedling to its arrival in the classroom. Have the last step show a piece of crumpled paper thrown into the trash.

Select the best drawing from each group.

Arrange them in chronological order.

Label the steps "The Cost of a Piece of Paper" and display it (perhaps in the office or some other central place in the school so that many others will see it).

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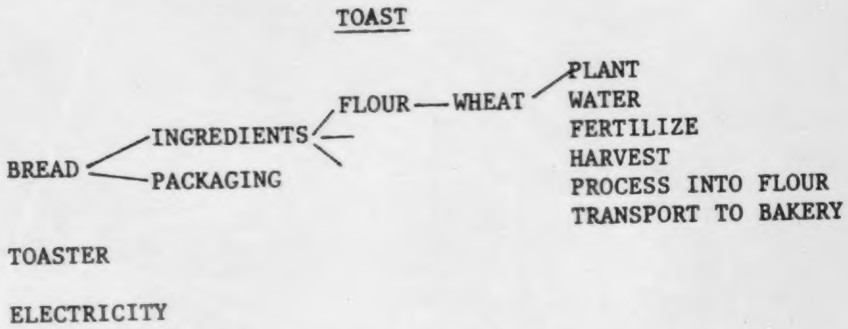
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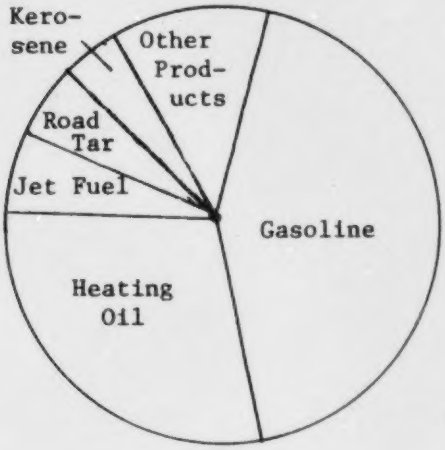
ACTIVITY 25

Learning: Many products are made from petroleum--an energy source.

Materials: A variety of references on petroleum, as available; "Petroleum Products" activity sheet, Appendix A-15.

Procedure: Reproduce the pie graph on everyday products refined from crude oil. Have the class look at the graph. Have students respond to the following questions:



"What does the largest part of a barrel of crude oil provide?" (gasoline)

"How do we use gasoline?"

(Ask similar questions for heating oil, jet fuel, road tar, kerosene.)

"What might be some 'other' products?" (insect sprays, weed killers, rust preventatives, paints, detergents, synthetic rubber, plastics, petroleum jelly)

Record any answers that come up. You may need to lead class.

From the pie graph draw the conclusion that "other" products is as big a piece of pie as jet fuel and asphalt combined.

Have students name some products made from petroleum. List them on the board. If students cannot name at least 10, give them some help. (gas for cooking, fuel for heating, gasoline for automobiles, asphalt, rubber, paints, polyethelene food containers, phonograph records, garden hoses, insect sprays, lipstick, aspirin, perfumes, detergents, plastics)

Distribute "Petroleum Products" activity sheet, Appendix A-15.

Evaluation: Have students find five examples within the school (or at home) of "other uses of petroleum" (uses that are new to the students as a result of doing this activity).

PETROLEUM PRODUCTS

List 10 products that are made from petroleum in the spaces below:

1. ________ 2. ________ 3. ________ 4. ________ 5. ________

6. ________ 7. ________ 8. ________ 9. ________ 10. ________

Now that you know the names of 10 different products that are made from petroleum, pick any five products and write them down below. Look them up in the dictionary and write what you find out about them. Could you find or bring in an example of one of the products that you have recorded on this sheet?

Product	Information I Found in the Dictionary
1.	
2.	
3.	
4.	
5.	

What product do you use most? ________________________________

____

What product do you use least? ________________________________

____

List the products that we could use something else in place of. Tell what could be used instead that would not use oil.

________________________ ________________________

________________________ ________________________

________________________ ________________________

________________________ ________________________

OBJECTIVE 4: *Students will give examples of how the availability of natural resources affects the way people live.*

ACTIVITY 26

Learning: When a natural resource is limited, it affects the way we live.

Procedure: Say to the students:

> "Let's pretend that we all live in a town called Drinkwater. It is a beautiful town with lots of big trees, flowers, green lawns, parks, swimming pools, and a beautiful river that runs through the town."
>
> "We love this river and have many uses for it. What do you suppose are some ways that we use water from our river?" (List responses on the chalkboard.)
>
> "Several years ago, a terrible thing began to happen to our river. Because it did not rain, the river became smaller and smaller. Now that the river is smaller, we do not have as much water to use. How will our lives change because there is less water?" (List responses on chalkboard.)

Have students list ways in which water is used in and around their homes.

Then have them pretend that the mayor (of Drinkwater) has asked every family in the town to give up all but *three* uses of water in each home.

Have students look at their list and circle the *three* uses of water they would not want to give up.

Ask for reasons for these three uses being so important to them.

Say: "Water is a natural resource that is more limited at some times than at others. When we can't use as much water as we once did, it changes our lives."

Evaluation: Have students list the ways they use oil (another limited natural resource). Be sure they consider the *many* uses of oil (bug spray, detergents, paint, plastics, synthetic fabrics for clothing, carpeting and draperies, as well as gasoline).

Have them circle the *three* ways they would not want to give up.

Have each student write a sentence stating how giving up these things would affect his/her life.

ACTIVITY 27

Learning: Our classroom life-style would be very different if we could not use electricity, natural gas, and petroleum for energy.

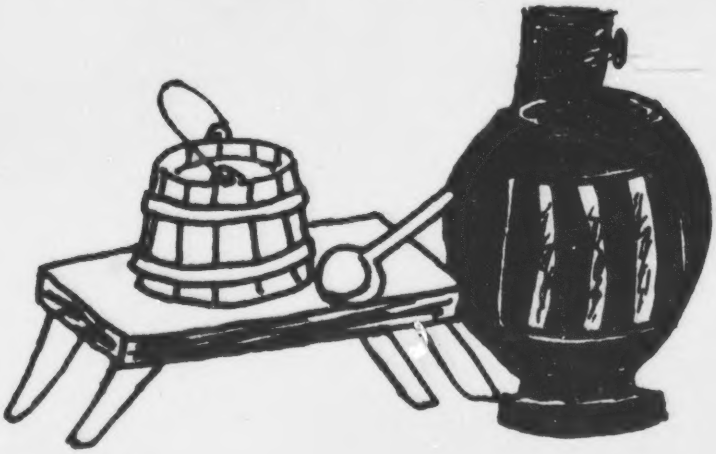
Materials: Crayons, paper

Procedure: Say to the children:

> "Look around our classroom. What things in the classroom depend upon some type of energy to operate?" (List on the chalkboard.) "Now, let's pretend that electricity, natural gas, and petroleum cannot be used in our classroom. What changes would this make in our classroom? How would our classroom be heated? What sources of light could we use? Would we need a motion picture screen?"

Have students draw a picture of how school rooms might have looked in the days before these energy sources came into use.

Share the pictures and have students explain.



Evaluation: Have students write a story together about what their own classroom would be like without electricity, natural gas, and petroleum. (Remind them of petroleum products that we use today.) Think of a title for the story (perhaps "What a Different Life" or "What a Difference Energy Makes").

ACTIVITY 28

Learning: We use natural resources. Giving them up changes the way we live.

Materials: 12" x 18" manila, writing paper

Teacher Information: The format for Haiku is three lines: The first line has five syllables, the second line has seven syllables, the third line has five syllables.

Procedure: Explain to students that trees are a natural resource. Because we can grow more trees, they are a renewable resource. They are, however, limited because it takes time for a new tree to grow when one is cut down, and much of our forest land is now being used for other purposes.

Have children fold a 12" x 18" piece of manila paper into eighths. Tell them to draw *eight* different ways a tree could be used. If they cannot think of that many ways, have them look through some books, an encyclopedia, or a dictionary for ideas.

Explain the format for writing Haiku and develop a sample with the class. After the drawings are done, have students write a Haiku poem about one of the pictures.

Example:

Houses built of wood,
Trees cut down from our forests,
To make homes for us.

Paste the Haiku on the back of the drawings.

Evaluation: Have students circle *three* of the uses of a tree they would not give up. Explain how giving up these uses would change the way they live.

Extended Activity: Use other natural resources and repeat the activity several times.

OBJECTIVE 5: *Students will give examples of career opportunities in the area of energy and ecology.*

ACTIVITY 29

Learning: There are many careers in ecology and energy.

Materials: "Worker Wheel of the Future (next page); "Ecology-Related Job Descriptions"(Appendix A-16); "Energy-Related Job Descriptions" (Appendix A-17); "Thinking About Jobs" activity sheet (Appendix A-18).

Teacher Information: For solutions to future energy and environmental problems, we need to help students become aware of careers in this field. Background information on energy- and ecology-related work is in the Appendix.

Procedure: Explain to students that, as we learn about energy and how we use it, we learn that we are paying a price for it. It is future generations that will be solving many of our problems.

Ask:

"What is our best bet for a cleaner world in the future?"
"How can we protect the standard of living we enjoy today from pollution?"
"How can we make sure we don't run out of energy?"

Say to the children:

"We must take the same skills, tools, and energies that have brought us to our present living conditions and use them to solve the problems of pollution and energy use."

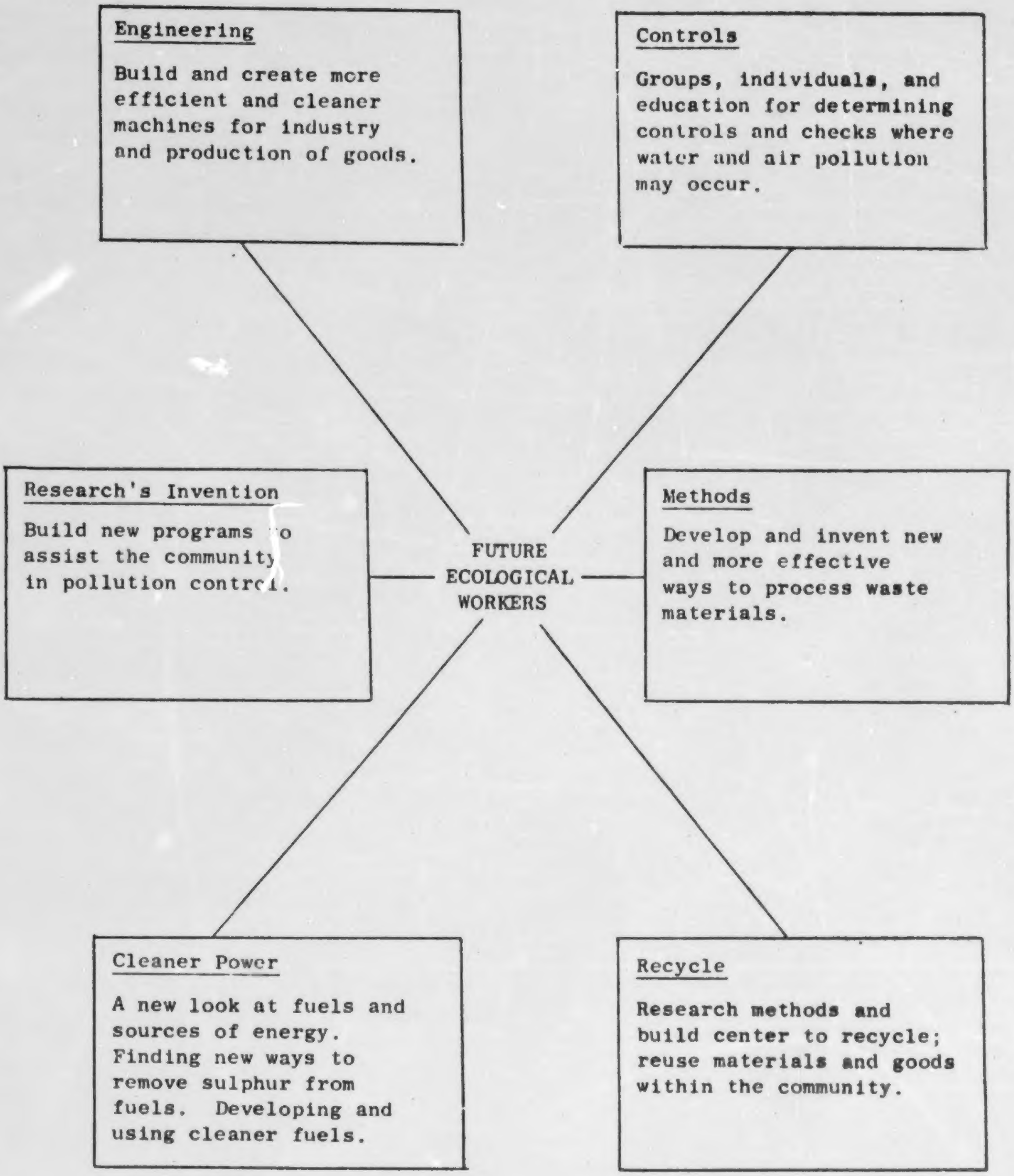
"Look at the "Worker Wheel of the Future" and see what careers will be needed to solve our problems."

Use the wheel for discussion. Have students identify specific occupations, skills, and ecology problems related to the occupations.

Read some job descriptions from "Energy-Related Job Descriptions" and "Ecology-Related Job Descriptions" and discuss them. List them on the board as they are discussed.

Evaluation: Have each student complete the "Thinking About Jobs" activity sheet and discuss them as a class.

WORKER WHEEL OF THE FUTURE



Engineering

Build and create more efficient and cleaner machines for industry and production of goods.

Controls

Groups, individuals, and education for determining controls and checks where water and air pollution may occur.

Research's Invention

Build new programs to assist the community in pollution control.

FUTURE
ECOLOGICAL
WORKERS

Methods

Develop and invent new and more effective ways to process waste materials.

Cleaner Power

A new look at fuels and sources of energy. Finding new ways to remove sulphur from fuels. Developing and using cleaner fuels.

Recycle

Research methods and build center to recycle; reuse materials and goods within the community.

ECOLOGY-RELATED JOB DESCRIPTIONS

Meterologist. Studies changes in the earth's atmosphere. Collection of weather data is a key job of a meterologist. Air pollution is a basic problem also studied by a meterologist. Requirements: 4 years of college and at least one year of graduate school.

Oceanographer. Examines the ocean, its contents, and movements. Looks for new ways to solve environmental problems connected with the ocean.

Sociologist. Studies people and groups of people. Looks at organizations and the environment in which they live. Requirements: 5-7 years of college including graduate school.

Writer. Informs citizens about ecology and how it affects their daily lives. Looks for solution to ecology problems.

Lawyer. Studies and helps create laws to protect the environment. Requirements: 7 years of college including law school.

Physiologist. Studies animals, organs, tissues, and cells. Studies the processes as they relate to environmental problems. Requirements: 5-7 years of college including graduate school.

Epidemiologist. Studies diseases of human. Interest in the environmental balance between disease carriers and their natural predators. Requirements: 10 years of study including college and medical school.

Geologist. Studies the earth's crust, its structure and composition. The geologist is a key to understanding the use of the environment. S/He looks for energy sources such as oil and natural gas. Requirements: 4-7 years of college and graduate school.

Toxicologist. Looks for poisonous substances in environmental areas. Requirements: 5-7 years of college and graduate school.

Urban Planner. Examines urban problems, works with agencies to prevent and solve urban connected problems. Checks the needs of the city as related to the environment.

Soil Conservationist. Works with farmers and other interested groups in the management, use, and care of soil. Works closely with environmental problems related to land use. Requirements: 4 years of college.

Aquatic Biologist. Studies the plant and animal life underwater. Interested in maintaining the balance of life underwater. Requirements: 5-7 years of study including college and graduate school.

Entomologist. Studies insects and how they affect other forms of life. Specializes in insects that carry disease or spoil food. Requirements: 5-7 years of college including graduate school.

Teacher. Educates and introduces individuals to the problems and responsibilities of the environment. Creates environmental awareness and motivates individuals to work on solving these problems. Requirements: 5 years of college.

Environmental Engineer. Uses the concepts of engineering to provide methods and ways to solve the problems of ecology. Covers all areas of air, water, noise, health, social, and economic interactions. Requirements: 4 or more year of college.

Physician. Cares for and treats individuals who suffer from the ill effects of an unhealthy environment. S/He not only works with diseases, but also checks safety and the effects on health of environmental pollutants. Requirements: 8 years of study including college, medical school, and internship.

Sanitarian. Manages programs and monitors accountability related to sanitation practices. Checks health standards to prevent outbreaks of illness. Enforces laws regarding handling and preparing of food for public use. Requirements: 4 years of college.

Solid-Waste Systems Supervisor. Supervises solid-waste collection, processing, and disposal systems. Requirements: 1 or 2 years of technical or vocational training.

Environmental Inspector. Checks and records environmental purity of air, smoke, water, and waste by using mechanical and chemical tests. Checks data and notifies the agency which is responsible for seeing to it that environmental standards are met. Requirements: 2-3 years of technical school or college.

Nuclear Technician. Tests nuclear waste disposal methods. Reports and assists in the development of machines and equipment. Works at nuclear power plants in the detection of radiation. Uses complex laboratory equipment. Requirements: 2-3 years of technical school or college.

Mechanical Tester. Checks air and noise pollution caused by engines. Monitors fuels and lubricants in engines and analyzes engine exhausts. Requirements: 2-3 years of technical school or college.

Incinerator Plant Attendant. Job responsiblities are to arrange for waste disposal in such a way as to minimize air pollution. Operates an incinerator, manages unloading solid-waste trucks. Fixes and maintains machines. Requirements: High school education and on-the-job training.

Wildlife Attendant. Works and operates fish hatcheries, refuge parks, and animal conservation areas. Watches animal development including breeding counts, and studies of fish, insects, birds, and other animals in their natural habitats. Requirements: High school education and on-the-job training.

Waste Water Treatment Plant Operator. Performs job that concerns the effective recycling of water and the removal and disposition of solid wastes. Works with specialized water pollution control equipment, i.e., takes readings, recordings, and samples of waste water. Requirements: High school education and on-the-job training.

ENERGY-RELATED JOB DESCRIPTIONS

Conservation Analyst. Reviews technical and engineering literature for new energy developments that would save customers money. Education: Prefer a college degree in Engineering or Economics.

Conservation Equipment Coordinator. Coordinates the sale of conservation products such as water saving shower heads, water heater blankets, and home insulation. Education: Prefer a college degree in Marketing or Business Administration.

Conservation Systems Engineer. Plans and develops energy conservation programs related to the design of company's electric distribution system. Education: Prefer a college degree in Electrical Engineering.

Consumer Affairs Counselor. Monitors changes in customers' attitudes and wants concerning the company. Education: Prefer a college degree in Business Administration or Public Relations.

Energy Advisor. Provides energy conservation and consumer product information to residential and commercial customers. Also assists residential and commercial customers in selecting efficient and economical appliances. Frequently travels throughout the community to conduct energy information programs to interested groups. Education: Prefer a college degree in Marketing or Business Administration.

Energy Utilization Engineer. Studies and recommends existing and potential use of energy by industrial and commercial customers. Education: Prefer a college degree in Engineering or Marketing.

Environmental Specialist. Develops, monitors, and coordinates company air quality programs for fossil and geothermal generating facilities. Education: Prefer a college degree in Meteorology or in Engineering, Chemistry, or Physics with specialization in Meteorology.

Farm Management Coordinator. Monitors and oversees the use of company farm lands, and informs the agricultural community regarding company land use plans. Education: Prefer courses in Real Estate and Agricultural Science.

Field Sales Representative. Provides assistance to industrial, commercial, and governmental customers concerning most efficient use of energy. Education: Prefer a college degree in Marketing, Business Administration, or Engineering.

Land Planner. Conducts land use and environmental impact studies. Meets with local governmental agencies and community groups concerning environmental regulations. Education: Prefer a college degree in Urban Planning, Environmental Studies, Civil Engineering, or Public Administration.

Sanitary Landfill Equipment Operator. Drives a gasoline or diesel powered tractor, power shovel, or other heavy equipment for the maintenance of a sanitary land fill. Requirements: Some high school education and on-the-job training.

THINKING ABOUT JOBS

Make a list of six different jobs that have something to do with energy and/or the environment.

1. ______________________ 4. ______________________

2. ______________________ 5. ______________________

3. ______________________ 6. ______________________

Write down the job you like best: ______________________

Write two reasons you might like this job:

1. ____

____

2. ____

____

What would you be doing to help our environment if you did this job? ______

____

____

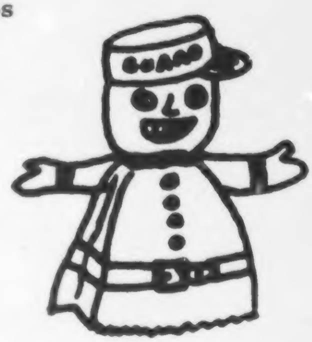
ACTIVITY 30

Learning: Many careers are available in the areas of energy and ecology.

Materials: Used paper bags, cloth or construction paper scraps, crayons, yarn scraps, felt-tip marking pens, glue, 18" x 36" construction paper, buttons, beads, etc.

Teacher Information: This project should be used to reinforce concepts of career opportunities related to energy and ecology.

Procedure: Review with the children some of the jobs that are available which are related to energy and ecology.



List as many of these as possible, so that there are as many different careers as there are children in the room. If this is not practical, assign children to work in pairs or groups.

Assign or have each child select a career s/he would like to illustrate.

Have each child make a paper bag puppet illustrating a person involved in this career. Then have them make a suitable background for this character on the construction paper.

Set up a table or desk in front of the chalkboard for the children to work behind. Then have each child come up and put the background drawing on the chalkboard and use the puppet to tell about his/her career. "I work for the Ecology Centre. My job is to ______________________."

ACTIVITY 31

Learning: Many occupations are involved in the discovery, production, and distribution of energy sources.

Materials: Mural paper, yellow chalk, crayons, used paper with one clean side, paints, brushes, containers of water

Teacher Information: This activity could be used as a culminating activity for a study of careers which make our use of energy possible.

Review with the children the energy careers that they have studied. List them on a chart or on the chalkboard.

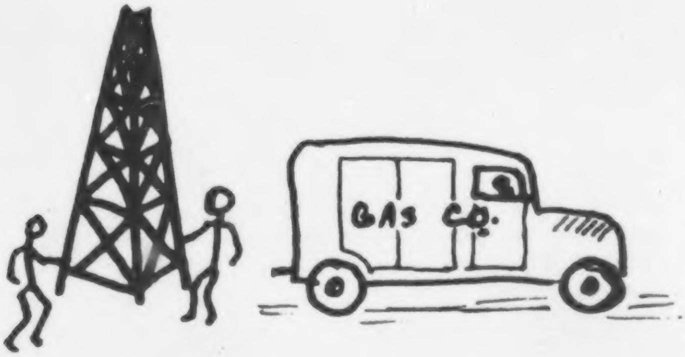
Then have the children select one of the careers that they want to illustrate, and ask them to draw it with their crayons on a piece of scrap paper.

Select a number of the best drawings; enlarge these on the mural (using the yellow chalk). (This can be done with an opaque projector.)

Paint the mural; three or four children may work together at a time.

Evaluate the mural. Suggest ways to improve it and give it unity. Add the improvements (select two or three good painters for this).

Evaluation: Are the occupations shown on the mural representative of some that are essential to the production and distribution of energy? Is the mural attractive as well as informative?



OBJECTIVE 6: *Students will explain social responsibility for energy consumption.*

ACTIVITY 32

Learning: A policy is a set of rules that helps guide our actions.

Materials: 9" x 12" colored construction paper, pencils, felt pens or crayons, 6' x 8' lengths of butcher paper.

Teacher Information: This activity will help children understand that a policy is a set of rules or actions designed to accomplish a goal. Webster defines a policy as "a course of action."

Procedure: List several school rules on the chalkboard. Examples should include rules devised by the school district, principal, teacher, and students. Examples:

1. Lining up in the cafeteria
2. Obeying the safety patrol
3. Getting permission to leave the classroom
4. Bringing an excuse when absent
5. Attending school
6. Making noise in the classroom
7. No running in the classroom
8. (Some standard the children have made or have agreed upon.)

Ask: "Who makes these rules?" (Discuss various sources of rules and provide input where necessary.) Say: "Our rules at school are called 'school policy.' Why does a school need a policy about behavior? How do these rules help you? How do they 'bother' you? How are policies made? What are some policies that you have helped make?"

Explain that we know enough about energy and how it is affecting the environment now to make an energy policy for our room. While we, as *one* classroom, cannot make an energy policy for the entire school, we can make some suggestions and perhaps start working on a school energy policy.

Divide the class into groups of three. Have each group develop some rules about energy for the classroom or the school. Have them write the rules out so that they are stated clearly. Encourage them to state the rule positively rather than as a "don't."

Divide the butcher paper into two columns with headings, "Classroom Energy Policy" and "School Energy Policy."

OBJECTIVE 6: *Students will explain social responsibility for energy consumption.*

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Learning: A policy is a set of rules that helps guide our actions.

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Divide the butcher paper into two columns with headings, "Classroom Energy Policy" and "School Energy Policy."

ACTIVITY 33

Learning:	Families have policies that help guide their actions about energy.
Materials:	Letter to parents (Appendix A-19)
Procedure:	Review the definition of policy from the previous lesson. Discuss: "What are some policies you have around your home? Who makes them? Are there policies that you and your family decide on together? What policies does your family have about the use of energy? If you could make a policy about energy use in your home, what would your policy be?" (Remember, a policy is more than *a* rule.) Tell the students that they are going to do something very special with their family. Distribute the parent letter and discuss it with the students so that they understand it. Have them fill in the salutation and take it home.
Evaluation:	Invite children to share the new energy policy that their family has agreed to adopt. Ask how they feel about helping to make an important policy for their family.

Dear ______________________:

Our class is learning about energy. As part of our work, I need to find out what energy policies we have in our home. I would also like to help make a new energy policy for our home.

I. Rules to conserve energy we already have in our home:

____

____

____

II. Some rules to conserve energy we could have:

____

____

____

III. A new energy policy we are all willing to adopt:

____

____

____

Signed by all members of family

____

____

____

____

____

ACTIVITY 34

Learning: The individuals who live in a particular household determine the policies within that household. Some of these household policies are directly or indirectly related to the use of energy.

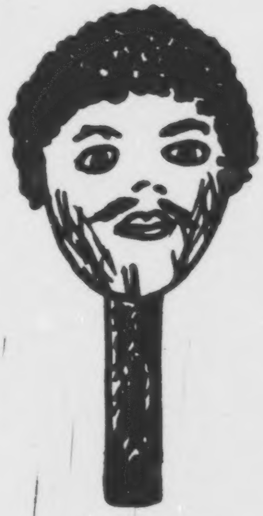
Materials: Construction paper 9" x 12", yarn, crayons, stapler and staples, water color marker, glue, scissors, chipboard strips

Teacher Information: Before beginning this project with the children, discuss with them some of their household policies (rules)--who makes them, and which of them are directly or indirectly related to the use of energy in the home. Example:

> Everyone in the family eats meals together. Energy is conserved because the food does not have to be reheated for late-comers.

Procedure: Divide the children into groups to represent families. Vary the composition of the family groups.

Let each child select the family member he/she would like to portray. Then have each child make a mask to represent the role he/she is portraying. When the mask is completed, staple it to a chipboard strip so that a handle is formed.



Have the members of each group practice pretending that they are having a family discussion to determine policies relating to the use of energy in their homes. Some coaching by the teacher may be necessary during the practice sessions to make sure that all members of the group participate in the discussions.

When the group is ready to make their presentation to the rest of the class, have them sit in a semicircle in front of the class with the masks held at arm's length in front of their faces.

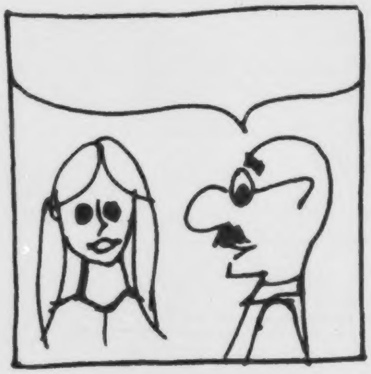
aluation: After each family group presentation, have the observers discuss who made the decisions in the family and what energy-saving policies were adopted by the group.

ACTIVITY 35

Learning: Family policies can conserve energy.

Materials: Newspaper, paste, stapler with staples, newsprint strips 4½" x 24" (cut from 18" x 24" paper), fine-line water color markers, crayons or colored pencils

Procedure: Ask the children to think of some ways in which they have infracted a household policy related to energy use. (You will probably have to give them some suggestions to help them understand what you mean, such as playing the television after being told to turn it off, forgetting to turn off the light, filling the bathtub with hot water, playing with the garden hose, leaving the door open when the heat is on, leaving the refrigerator door open while deciding what you want from the inside, etc.)



The children can then develop a comic strip sequence showing what they did and how their parent(s) reacted. Draw balloons showing what is being said in each panel.

Paste each finished comic strip on a sheet of newspaper until the sheet of newspaper is full of comic strips.

Continue this until all of the comic strips are pasted on newspaper sheets. Then cut off the excess newspaper and staple all of the sheets together.

Allow the children to read the comic strips in their free time. When they have tired of them, share them with another class.

Evaluation: Have students write a sentence explaining why household energy policies will help our national environmental problems.

ACTIVITY 36

Learning: Our energy sources could last longer if we used less than we do now.

Teacher Information: Some experts in the field of energy maintain that the "energy crisis" is a "fuel crisis." While there are many reasons for this crisis, they make the point that the main reason we are running out of fossil fuel is just that we are using so much and using more and more every year.

Procedure: Explain that there are two ways to deal with a shortage of anything--"get more" and "want less." Make sure students know what these two terms mean. Write on the board the two terms: "get more" and "want less."

Have students brainstorm specifics under these two headings. ("What would be some ways to 'get more'?" "Name some ways we can 'want less,' e.g., do without so much.")

Looking at the first group ("get more"), ask:

> "What would have to happen for *this* one to take place?" (Look at each item separately.)

Look now at the second group ("want less") and ask:

> "What would have to happen for this to take place?" (Look at each item separately.)
>
> "Looking at what we have just done, which of these seems to be something that we can be doing *right now*? How would it help the 'crisis'?"
>
> "Which of these things seems more long-range, something that will help prevent a crisis in the future? Which of these things can we as individuals be working on while special people like scientists and engineers are working on the long-range things?"

Evaluation: Have students complete this sentence:

> "I believe that people in this city can help in the energy crisis by ______________________________."

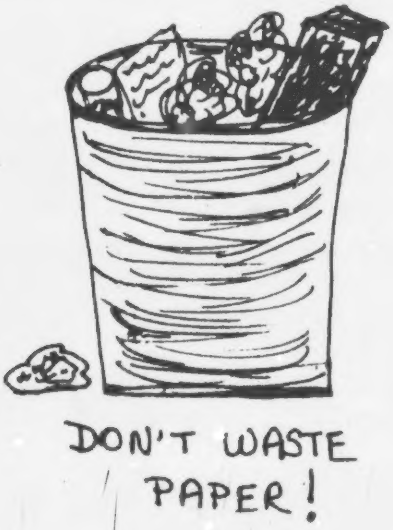
Have them illustrate their point. Use the papers for a bulletin board display. The caption might be "Is This Crisis Necessary?"

ACTIVITY 37

Learning: The conservation of energy has to begin with each individual.

Materials: Construction paper 24" x 36", felt-tip markers, crayons, paints, chalk, construction paper scraps, yarn

Procedure: Have children design a poster to be hung in the cafeteria, auditorium, learning center, etc., where it can be seen by other children in the school. The poster should show some way to decrease energy consumption. The children should have a free choice in the materials used in making the poster so there will be a variety of styles of expression.



Evaluation: Have students explain how their poster could help energy conservation.

ACTIVITY 38

Learning: We need to evaluate our own personal use of energy.

Materials: Electrically controlled toys and/or appliances which function solely for recreation. (Pictures of toys/appliances will serve if the real objects cannot be brought to class.)

Procedure: Ask students to bring to school and discuss electrically controlled or powered appliances and toys which function solely for recreation or entertainment. Some items may be too large to take to class, so students can bring a picture or description. Have a class discussion to avoid duplications and to decide whether or not battery-powered items should be included.

Some students may want to research each item with questions such as:

> "How long has this item been on the market?"
>
> "Was it marketed to fill a need, or did its appearance on the market, along with its advertising, create its own need?"
>
> "If it indeed fills a need, can we think of alternative diversions which require no energy consumption?" These may already exist or be created by the students.

Set up a display of the electricity-powered items and their non-powered counterparts.

Evaluation: Conclude that many recreational uses of energy could be avoided.

ACTIVITY 39

Learning: Our own personal values are reflected in the way we view our environment.

Teacher Information: This activity is called Rank Order. It is designed to help students look at what they say they value in our environment. This is an adaptation from an activity in Sidney Simon's *Values Clarification*.

Procedure: Put the statements and words on the chalkboard or a piece of large newsprint. Have volunteers rank the alternatives in order of their preference (or select only one of the alternatives), and give reasons for the ranking.

Examples:

1. There is a small budget to spend on the litter problems in your neighborhood. How would you like to see the money spent?

    ____ buy litter containers
    ____ put "NO LITTERING" signs up
    ____ hire someone to pick up litter

> NOTE: Be sure to have the student give reasons for his/her ranking, e.g., "Why would your first choice be to buy litter containers? Why would you not want the money spent to hire someone to pick up litter?"

2. What would be the worst thing to have happen?

    ____ to have to walk to school
    ____ to not be able to have electrical toys
    ____ to not be able to watch TV

3. It's a nice day outside and you want to go to the store three blocks away for an ice cream. Would you:

    ____ get your Mom to drive you
    ____ walk
    ____ ride your bike

4. Which would you rather *BE?*

    ____ a plane ____ an automobile
    ____ a motorcycle ____ a 10-speed bike

5. What is the most unpleasant sound to you?

    ____ motorcycle
    ____ low-flying airplane
    ____ traffic

6. What is the ugliest sight to you?

____ trash in a park
____ a vacant lot filled with weeds
____ a junk car on a neighborhood street

7. What smell do you dislike most?

____ bus exhaust
____ stagnant water
____ smog

Evaluation: Have students discuss what they learned about themselves through this activity and what they learned about the group.

ACTIVITY 40

Learning: Our own personal values are reflected in what we do.

Teacher Information: This activity is called Values Continuum. It is designed to help students look at the way they use their environment and see what values this reflects. It is an adaptation from an activity in Sidney Simon's *Values Clarification.*

Procedure: Explain to students that a continuum defines both ends as extremes and then has "gradations" in between these extremes. For example:

> 1 on a continuum might be hot and 5 on that continuum would be cold; 2, 3, 4 would be gradations between hot and cold.

Draw a line on the board with 1 at one end and 5 at the other end and 2, 3, and 4 in between:

1 2 3 4 5

Define each of the extremes (1 and 5) as though they are people. Each will have a name and at least one "energy-related" characteristic.

Tell students that you are going to ask them an energy-related question. Then you will describe the kind of person that would be found at each end of the continuum.

Have students answer the question *for themselves* by deciding where they would be on the continuum. Example:

1. The question is: "How do you use electric energy?"
2. On the #1 end of the continuum is Eddie Electric. He uses energy like there is no tomorrow. He even owns an electric page turner so he won't have to turn the pages of the books he reads.
3. On the #5 end of the continuum is Barry Bulbsnatcher. He has only one light bulb for his whole house, and he carries it around from room to room.
4. Say: "The question is, 'How do you use electric energy?' Are you an Eddie Electric who uses energy as though it will never run out? Or are you a Barry Bulbsnatcher who is so afraid of using too much energy that he only owns one light bulb? *OR* are you somewhere in between?"
5. Ask for volunteers to tell the class where they think they fit on the continuum.
6. Allow as many children to respond as possible. Every now and then, ask a child to give an example that would explain why s/he thinks s/he fits in that particular place on the continuum.

Other continuum ideas:

"How do you feel about using gasoline?"

#1 Bike-riding Betty. She doesn't use any gas-using vehicles at all. She rides her bike everywhere she goes.

#5 Motoring Mable. She uses the car every chance she gets. She even gets her Mom to drive her next-door to her friend's house.

"How do you use water?"

#1 Stanley Saver. He doesn't waste a drop of water. He even uses the water when he changes his goldfish bowl to water his garden.

#5 Walter Waster. He figures that he can afford to pay for all the water he wants to use, so he hoses down his driveway every evening and leaves a sprinkler going near his window all night because he likes the sound of water running.

"How do you feel about air pollution?"

#1 Pure-Air Paul. He is so opposed to air pollution that he takes short breaths so he won't add as much carbon dioxide to the air.

#5 Pollutted Polly. She is so uncaring about air pollution she burns her trash in the back yard because she doesn't think to put it out for the trash pick-up.

Create your own. Children can think of many other examples. Each one can lead to good class discussion on energy and environment issues.

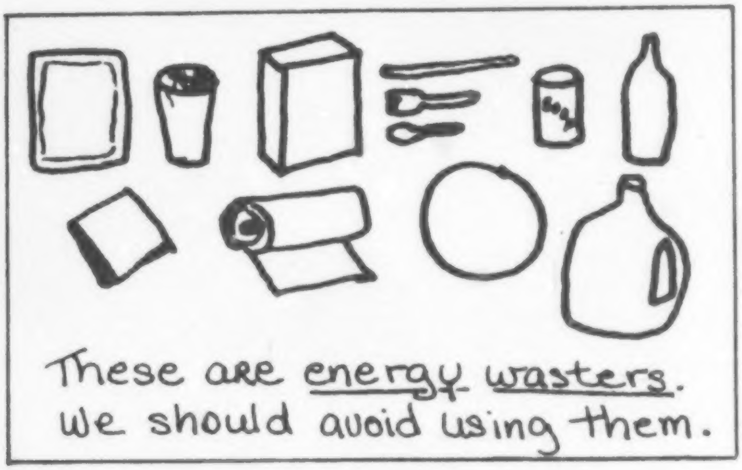
Evaluation: Discuss what was learned through this activity, (1) individually and (2) as a class.

ACTIVITY 41

Learning: Disposable products waste money, raw materials, and energy. It is our social responsibility to avoid these products.

Materials: Throw-aways (one brought in by each child), pointed scissors, glue, string, large size lightweight chipboard, bright colored construction paper (cut to size of chipboard), black felt-tip marker, paints

Procedure:


These are energy wasters.
We should avoid using them.

Glue the construction paper to the chipboard at the corners. Arrange as many different kinds of disposable products as possible on the paper, trying to create an interesting arrangement. Glue the objects when a pleasing arrangement is found. Tie on objects that tend to resist the glue. Then have a few children add some interesting designs with paint to make the display eye-catching.

Have the children decide upon a suitable caption. Put it on display. If possible, display this in a spot where teachers and children in the school will see it.

Evaluation: Use the chart to stimulate a discussion of why these products are wasters of energy and how we can avoid or cut down on using them.

ACTIVITY 42

Learning: Recycling will reduce the use of natural resources.

Materials: "How a Glass Bottle Gets to You" (Appendix A-20), "How an Aluminum Can Gets to You" (Appendix A-21), "From Logs and Mines to the Newspaper" (Appendix A-22), "Recycling Saves Energy and Resources" (Appendix A-23), extended activities, art (Appendices A-24 and A-25).

Teacher Information: After students have investigated some of the issues involving our use of energy and its impact on our environment, hopefully they will want to "do something" about some of these problems.

As a culmination to this unit, the last four activities involve the students in a recycling campaign. These activities are designed to make students aware of (1) how recycling helps conserve natural resources, (2) how they can help with litter problems around their school and neighborhood, and (3) how they might carry out a project to alert others to recycling.

Procedure: Say to students: "We have learned what our natural resources are and the many ways that we use them. We have learned that many of our resources are used to make things that are used once and then thrown away. What are some of these things?" (List some on the chalkboard as students name them. Leave the list on the chalkboard--you will need it later.)

Read the poem, "Everywhere is Somewhere."

> When you throw away a glass bottle,
> or an aluminum can,
> you have not really thrown it "away."
>
> A broken piece of glass on a path
> is somewhere....
> it is there.
> When you walk along that path,
> even years later,
> you can step on the glass and cut yourself.
>
> A can thrown behind a rock is there,
> even if you can't see it.
> It will go on being there
> for hundreds and hundreds of years.
>
> On the land,
> everywhere is somewhere.
> Nowhere is "away."

(from *Save the Earth!* by Betty Miles)

Ask:

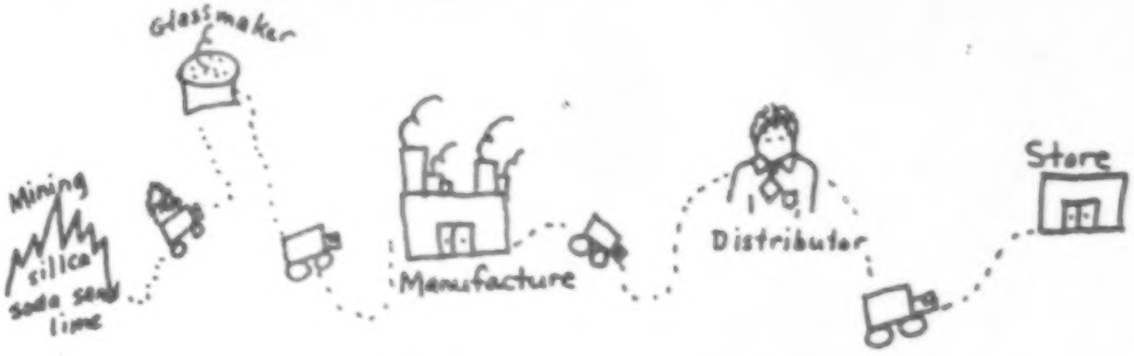
"What do you think the main idea of this poem is? What is its message?"

"Since we cannot really throw things 'away' (since nowhere is 'away'), what shall we do with all these things on our list?"

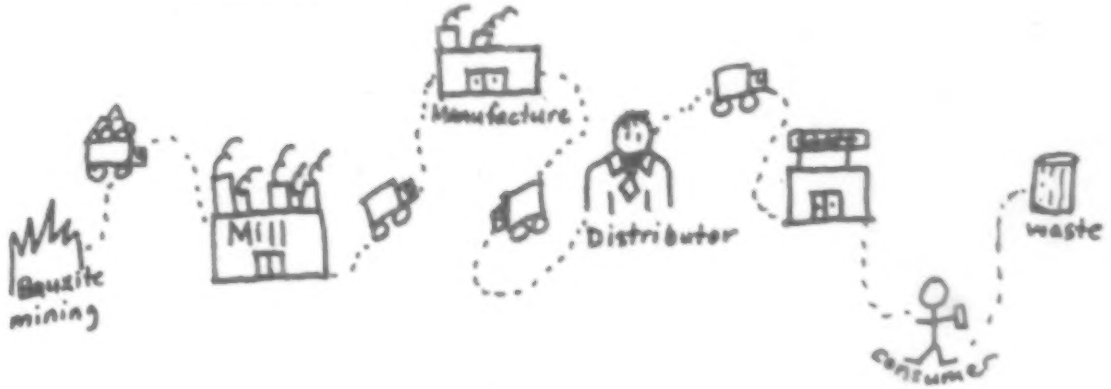
Say:

"Many things that are thrown away *could* be used again. This is called 'recycling.' One form of recycling is to make new uses for something (like making a flower vase from a plastic bleach bottle). There is another kind of recycling. This kind processes used materials back into their *original* use. There are three kinds of materials that are especially important for this kind of recycling. They are glass, aluminum (cans), and paper."

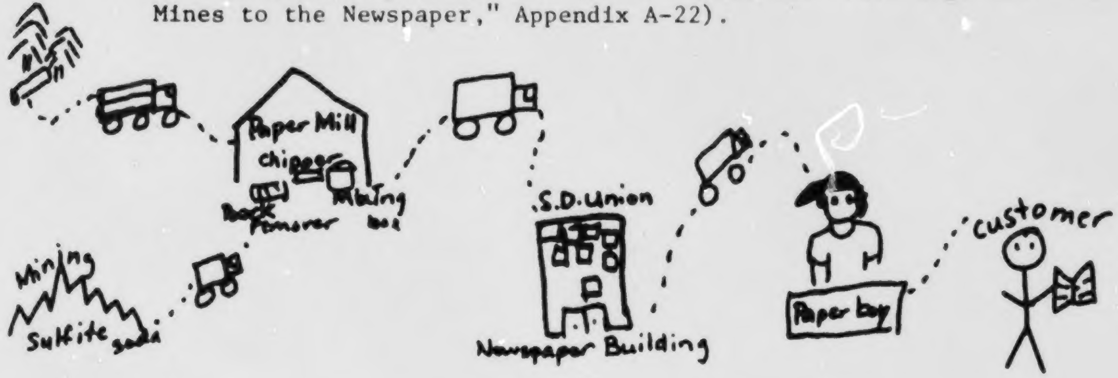
Give the students this data: Recycled glass is used to manufacture new glass and results in big energy savings. It takes much more energy to make new glass from "scratch" than from recycled glass. (As a visual you may use "How a Glass Bottle Gets to You," Appendix A-20.)


Glassmaker
Mining
silica
soda sand
lime
Manufacture
Distributor
Store

Aluminum takes 95% more electrical power to produce from ore than from aluminum scrap. (As a visual, use "How an Aluminum Can Gets to You," Appendix A-21.)


Bauxite mining
Mill
Manufacture
Distributor
consumer
waste

Recycled paper requires much less energy to make into new paper than if wood pulp were used, besides requiring less water and producing fewer pollutants. (As a visual, use "From Logs and Mines to the Newspaper," Appendix A-22).

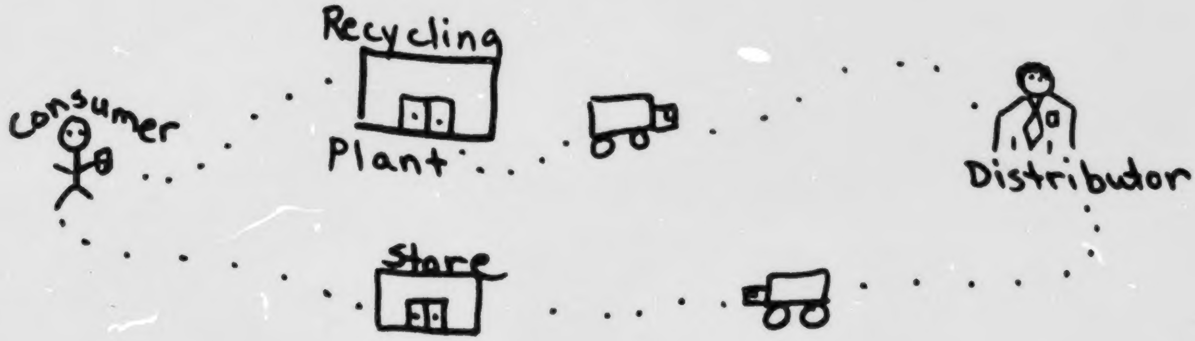

Paper Mill
chipper
Bark remover
Mixing box
Mining
Sulfite
soda
S.D. Union
Newspaper Building
Paper boy
customer

In one year, the people of the United States threw away:

28 billion bottles
48 billion cans
40 million tons of paper

Say: "Let's take a look now at our list and find the things that could be processed back to their original use." Code the items G (glass), P (paper), or A (aluminum).

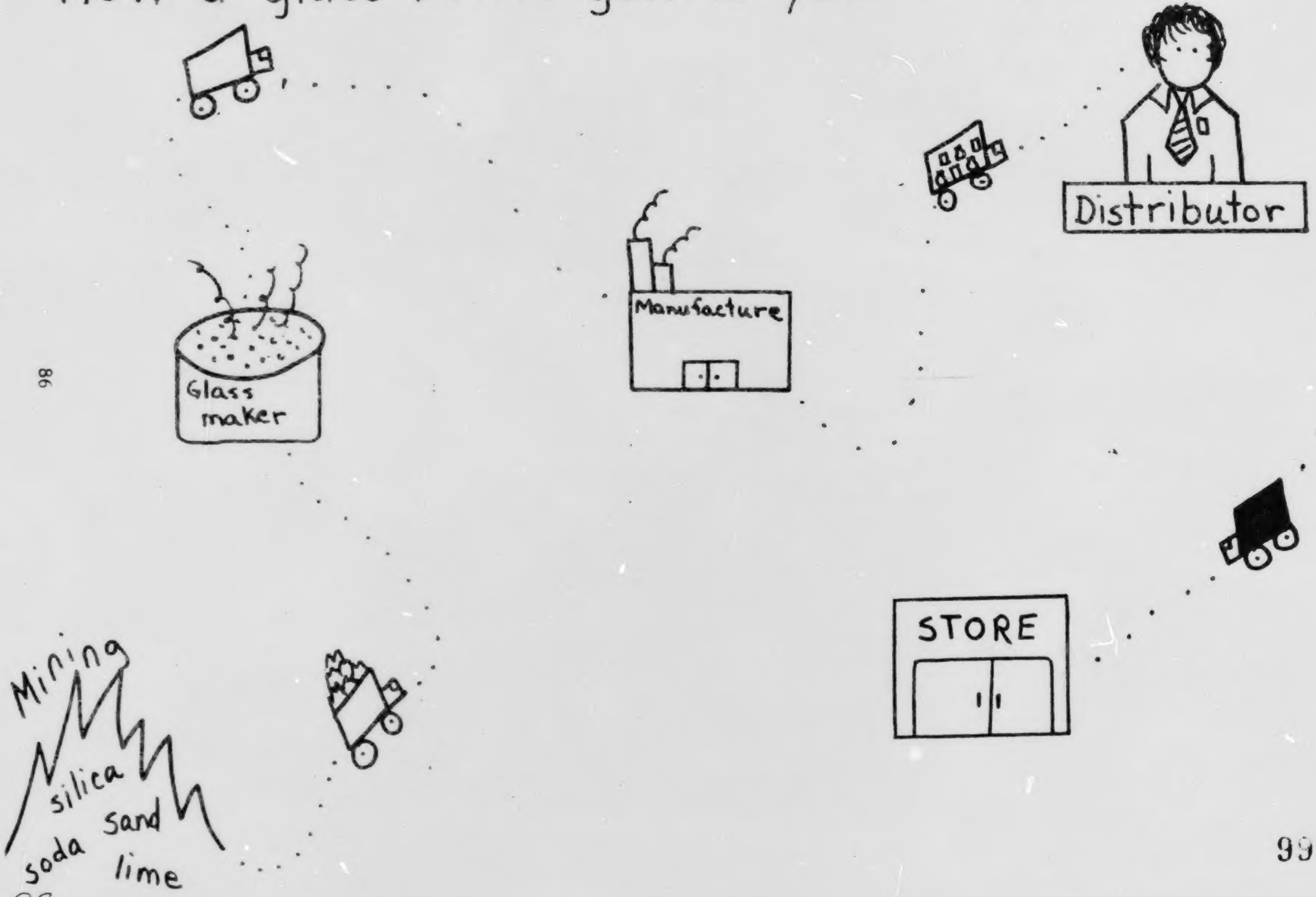
Discuss the steps that could be eliminated in the production of glass, paper, and aluminum through recycling.


Recycling
Plant
Consumer
Distributor
Store

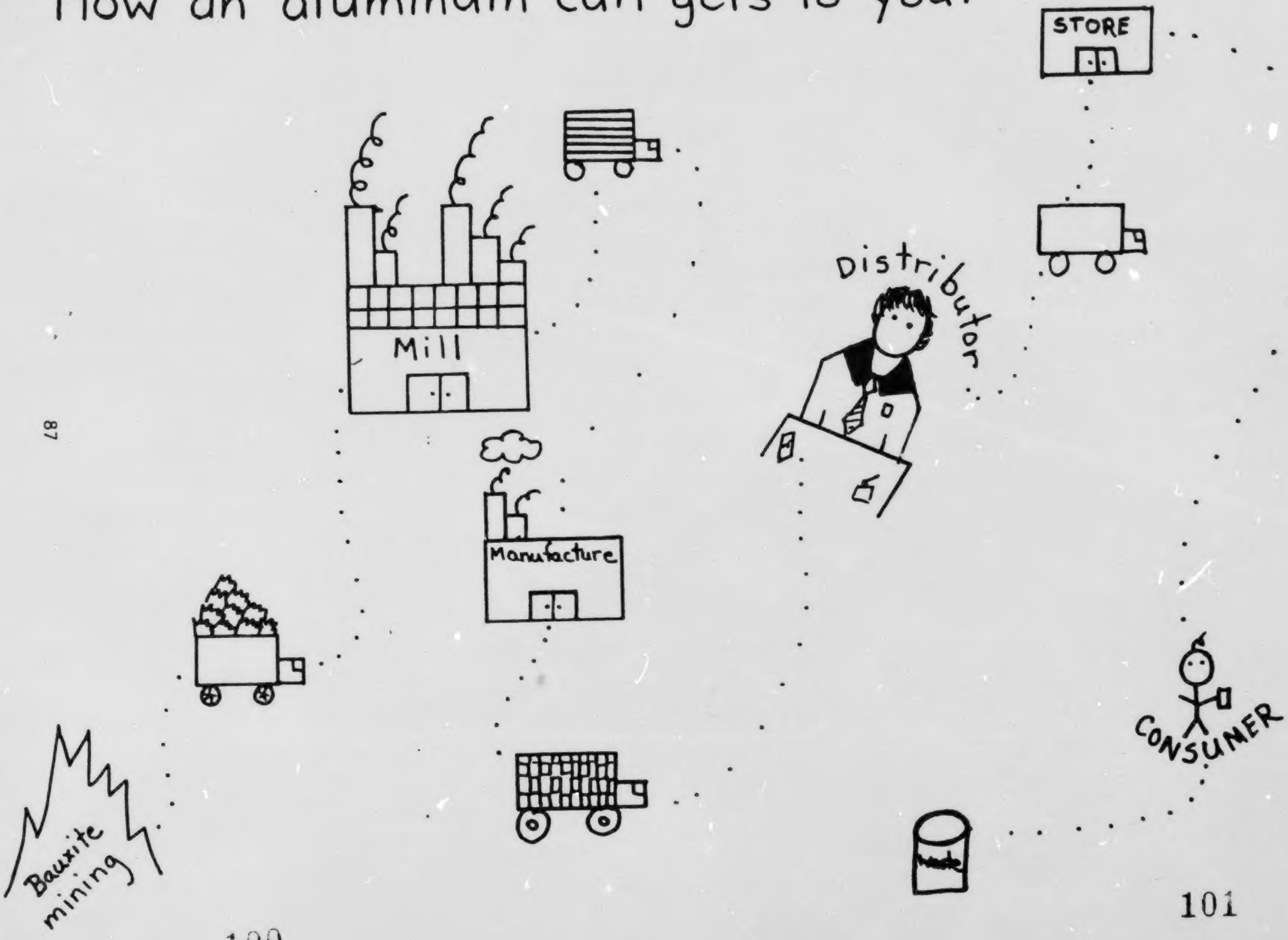
Evaluation: Have students write a paragraph explaining what recycling is and how they feel about the people of this country becoming more involved in recycling as a way to use fewer natural resources and less energy. Suggest they illustrate their paragraph.

Extended Activities: There are some art activities that utilize "throw-away" materials that may be found in Appendices 24 and 25.

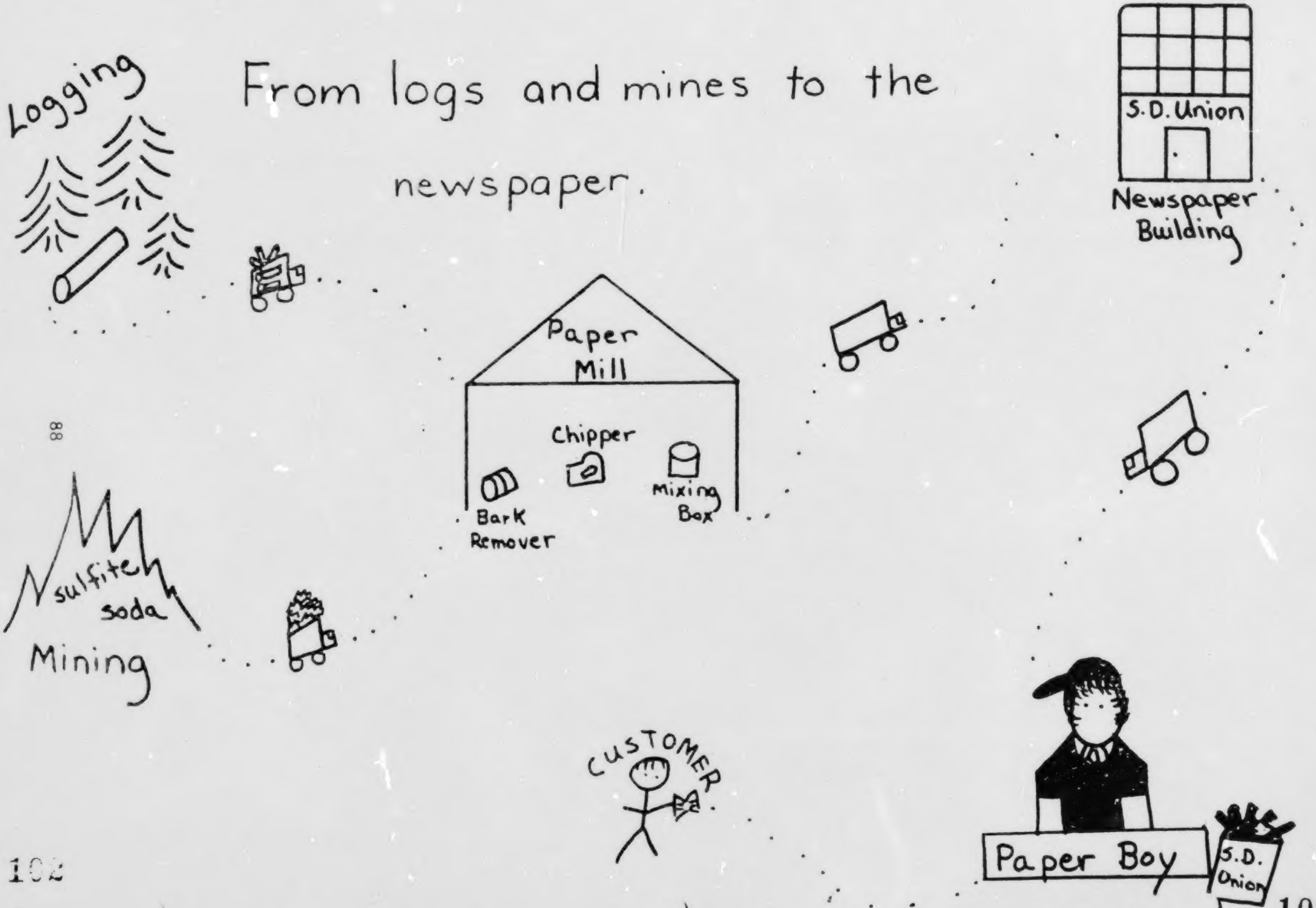
How a glass bottle gets to you.


Distributor
Manufacture
Glass maker
STORE
Mining
silica
sand
soda
lime

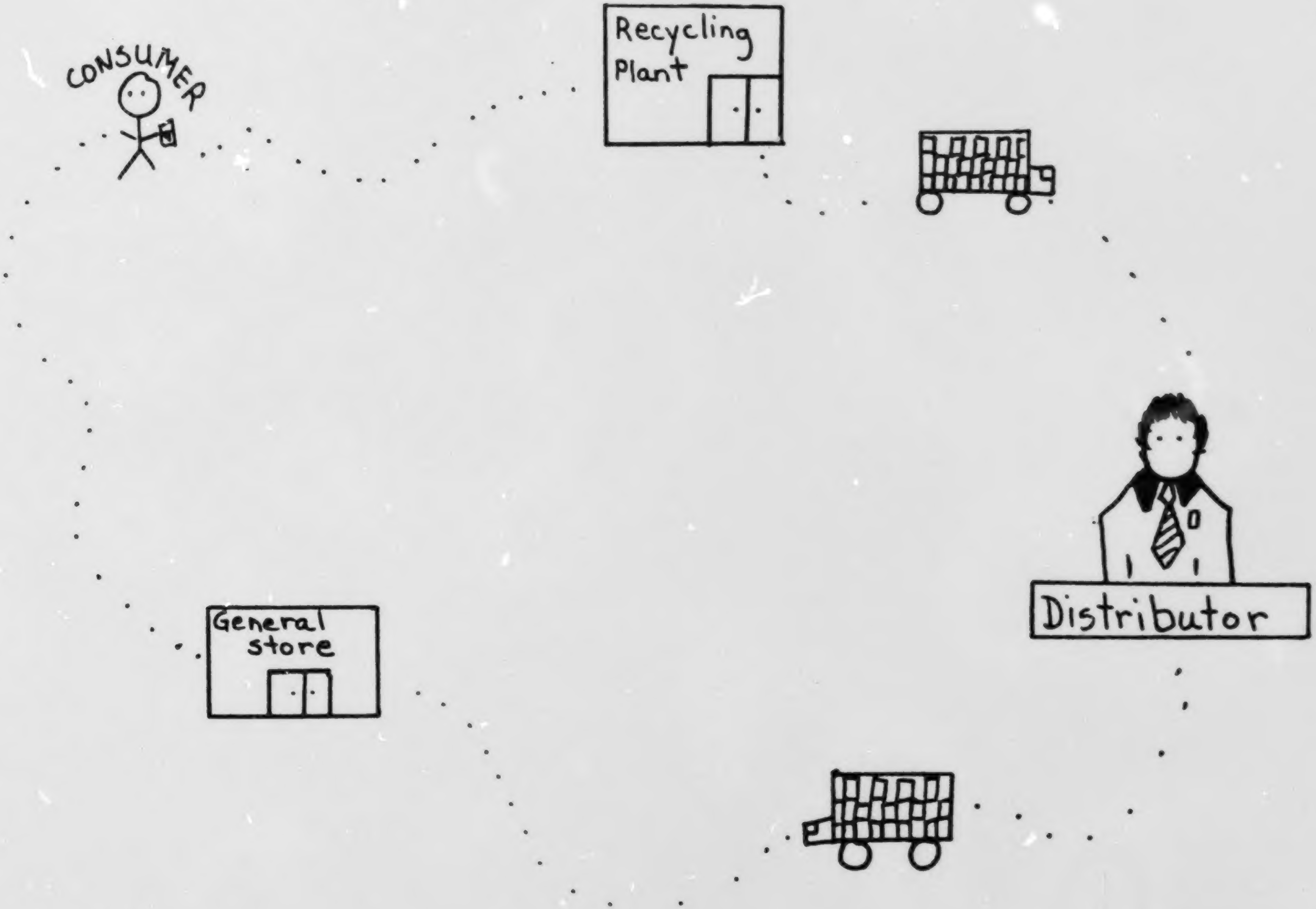
How an aluminum can gets to you.


STORE
Mill
Distributor
Manufacture
CONSUMER
Bauxite mining

From logs and mines to the newspaper.


Logging
S.D. Union
Newspaper Building
Paper Mill
Chipper
Bark Remover
Mixing Box
sulfite
soda
Mining
CUSTOMER
Paper Boy
S.D. Union

Recycling saves energy and resources.


CONSUMER
Recycling Plant
Distributor
General store

ACTIVITY 43

Learning: Recycling will reduce the use of natural resources.

Materials: Kit, "Recycling--We Care" (filmstrip, cassette, and teacher's guide), Recycling List (Appendix A-26).

Teacher Information: This lesson should follow Activity 42. From the paragraphs written in that activity, select a few that state some strong reasons for Americans to become more actively involved in recycling.

Procedure: Read several of the paragraphs from Activity 42.

Discuss reasons for becoming involved personally in recycling. Allow children to explore ways adults can be involved and ways children can be involved.

View the soundstrip from the kit "Recycling--We Care." After viewing, discuss the main points of the soundstrip. List the ways the film showed children involved in recycling. Ask if, as a class, they would like to begin a recycling campaign for their school and neighborhood.

If this is a class project that seems worthwhile, organize your recycle campaign:

List the workers you will need:

Poster Committee (to make posters to put around school and in the neighborhood)

Speakers Committee (to go around to other classrooms to appeal to other students to contribute to the drive). Encourage them to be creative about their presentations; puppets, news broadcast, TV interview, etc.

Flyer Committee (to make flyers to be distributed door-to-door in the neighborhood explaining the need for recycling and giving information on recycling centers)

> Note: The Recycle List in Appendix A-26 is updated every three months. Please call the Ecology Centre at 235-0066 for an updated list of information and recycle centers. The Paper Cube Co. (233-5209) provides classroom lectures and bins for paper drives.

Recycle Center Committee (to actually take the cans to the recycle center)

Note: Children should not bring glass to school. Encourage parents to take glass to the recycle center directly. Newspapers will be picked up at the school. (See the Recycling List for the number to call.)

EVERYONE is a collector (to bring in aluminimum cans and newspapers)

List other jobs that students think of in order to have a successful campaign. Get volunteers to fill these jobs.

Evaluation: Decide what you will do with the money you will earn from this campaign.

SAN DIEGO ECOLOGY CENTRE, INC.
340 Kalmia St.
San Diego, Calif. 92101
Phone: (714) 235-0066

RECYCLING LIST

Revised April, 1978

RECYCLING CENTERS

Operated by the San Diego Ecology Centre
Call 235-0066

Chollas Recycling Center
5851 College Grove Drive
Glass, bi-metal, newspapers, oil

Del Mar Recycling Center
N.E. corner Jimmy Durante &
San Dieguito Dr., Glass,
aluminum cans, newspapers

Rose Canyon Recycling Center
3775 Morena Blvd.
Glass and aluminum cans

A-1 Paper Recycling Center
3330 Broad Ave., San Diego-232-2363
801 W. Main St., El Cajon - Sat.8-12
Oceanside/Carlsbad-Plaza&College-Sat.8-2
Newspapers & Aluminum cans

Girls Scouts - San Diego Imperial
Council, Inc. - 298-8391
1231 Upas St. - newspapers, aluminum
cans, bi-metal cans, glass.

North Coast Family Y.M.C.A.-753-6536
200 Saxony Road, Encinitas
newspapers, aluminum cans

Ocean Beach Community Services
Recycling Center - 225-9305
5041 Newport Ave.
White office paper, aluminum cans

Community Hospital of Chula Vista
751 Dora Lane, Chula Vista
newspapers, aluminum cans
Mrs. Marylou Goodell - 420-1358

Recycling Center - 231-2521
2744 Newton St. - newspapers, glass,
aluminum and bi-metal cans

PAPER

Newspaper: See Yellow Pages under "Waste Paper" for companies that purchase newspapers.

The San Diego Newspaper Recycling Program provides pick-up of separately bundled or bagged newspapers (7am-5pm) from curbs and alleys throughout the city, every week on regular city trash pickup days. They must be readily seen from the street. For information call: 236-5661. Call:236-5906 request/pickup.

For further information regarding newspaper recycling bins located throughout the San Diego region call San Diego Ecology Centre, 235-0066 or Kiwanis Club, 278-6061.

Office Paper: The San Diego Ecology Centre provides free pickup of high quality office paper (bond, computer paper and cards, etc.) For more information call 235-0066.

Cardboard: See Yellow Pages under "Waste Paper".

Most supermarkets that have a bailing machine will accept heavy, non-slick type cardboard.

Magazines: Due to clay content most are useless for recycling. They can be used by senior citizens' clubs, beauty shops, barber shops, convalescent homes, schools, etc. Check local Goodwill Industries and thrift shops. Libraries need certain issues for reference material.

Misc. Paper: Check Yellow Pages under "Waste Paper". Most paper has some value. You can sell letters, pamphlets (not shiny paper), IBM paper and cards. You cannot sell carbon paper, magazines, single layered boxes or cereal cartons

GLASS

No window glass. Jars and bottles accepted. Labels need not be removed.

Glass Recycling Centers

Chollas Recycling Center - 235-0066
5851 College Grove Drive
8am-5pm except holidays

Rose Canyon Recycling Center-235-0066
3775 Morena Blvd.
24 hours-7 days a week

Girls Scouts - 298-8391
1231 Upas St.
8am-4:30pm; Mon-Fri.

Del Mar Recycling Center-235-0066
N.E. Corner Jimmy Durante Blvd.
and San Dieguito Drive
24 hours; every day.
Pay for aluminum Sat. 10-2pm.

Rancho Bernardo Recycling Center
W. Rancho Bernardo Rd. - 487-6608
(parking lot adjacent to Westwood
Shell Station) Aluminum donations
accepted.

Lake Murray Recycling Center-461-3750
Entrance to Lake Murray, off Lake
Murray Blvd. between Maryland Blvd.
and Highway 8. 24 hours; every day.

METAL

Alcoa, Yes We Can, 111 Elm, Suite 303
San Diego - 236-0126
Cans and TV trays accepted.

Reynolds Aluminum Recycling Co.-280-9545
4460 University Avenue

For location and time of pickup in your neighborhood, call the above or San Diego Ecology Centre - 235-0066.

Del Mar Recycling Center
Jimmy Durante Blvd. & San Dieguito Blvd.
Aluminum only.

North Coast Family Y.M.C.A.-753-6536
200 Saxony Rd., Encinitas
Aluminum & bi-metal cans
8am-9pm - every day.

Girl Scouts - 298-8391
1231 Upas St.
Aluminum & bi-metal cans
8am-4:40pm - Mon-Fri.

Recycling Center - 2744 Newton St.
Aluminum, bi-metal cans, heavy metal.

Metal Clothes Hangers: Check dry cleaners

Mercury Batteries: Used in power hearing aids, camera light meters, watches, etc.

McGirr's Jewelers, 3974 Clairemont
Mesa Blvd. N. Clairemont Square

ORGANIC MATERIAL

You can bury waste in a deep hole and wait for it to decompose or you can compost it by mixing it with other substances. There are many good books on the subject at your bookstore or library.

MISCELLANEOUS

Grease: See Yellow Pages under "Rendering Companies". Some will buy kitchen grease and supply a collection barrel for clubs, church groups, etc.

All Von's Markets will buy kitchen grease. Do not put in glass container.

Oil: Nelco Oil Refining Corp., 600 W.12 St. 474-7511, will pick up large quantities of oil. No charge if you take oil to plant.

Call Ecology Centre, 235-0066 for nearest Oil Recycling Center in your neighborhood.

Rags: See Yellow Pages under "Rags". Check local print shops, newspapers and schools.

Junk Cars: Want-ads. Yellow Pages under "Scrap Metal".

Scrap Craft Centers: Clean meat trays, jar lids, containers, cartons, string, buttons, etc. needed for projects. Check with schools, art classes, youth groups, churches, etc.

PRINTED THRU THE COURTESY OF:

Paper Cube Co.
931 East Harbor Drive
San Diego, CA
233-5209

Specializing in newspaper drives for schools, churches and clubs.

Top prices paid

ACTIVITY 44

Learning: Recycling will reduce the use of natural resources.

Materials: "Building a Can Crusher" (Appendix A-27), Word Search (Appendix A-28)

Teacher Information: Some tips to aid in your recycling campaign:

1. Do not allow children to bring glass to school. Suggest that parents take glass directly to the recycling center.
2. Flattened cans take up less space. Crush aluminum cans by stepping on them. Store them in a large garbage can or plastic bags.
3. Tie newspapers in bundles about 12" high. This way they are easy to stack and pick up and move.
4. Enlist as many parents as you can to become involved in your class project. They can help get the materials to the recycling centers.

Procedure: Have small groups make posters to put in as many places as possible around the school and the neighborhood. Be sure the posters tell *where* to deposit the cans and/or newspapers.

Have small groups work out and practice their presentation to other classes. It needs to be appealing!

One small group could write the project up as a newspaper article for a local paper.

Have a small group make flyers to distribute in the neighborhood to publicize the recycling campaign.

Practice with the entire class how to approach people in the neighborhood to enlist their help and support in the campaign by:

Contributing aluminum cans
Contributing newspapers
Taking their glass to a recycle center

One small group could make can crushers. See Appendix A-27 for directions.

Brainstorm for other activities that will make the recycle campaign successful.

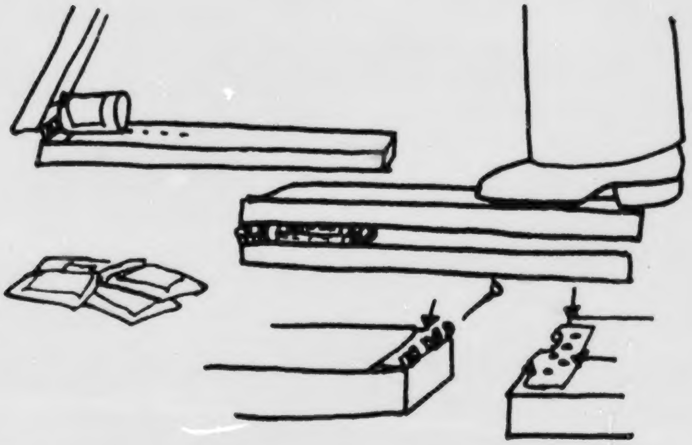
As students complete their tasks, they may want to do the word search in Appendix A-28.

BUILDING A CAN CRUSHER

Materials: 2 feet of "two by six" lumber, 2 feet of "two by four" lumber, heavy duty door hinge, 6 flat-head hinge screws 1½" long, 1 lag bolt ¼" x 1½" long.

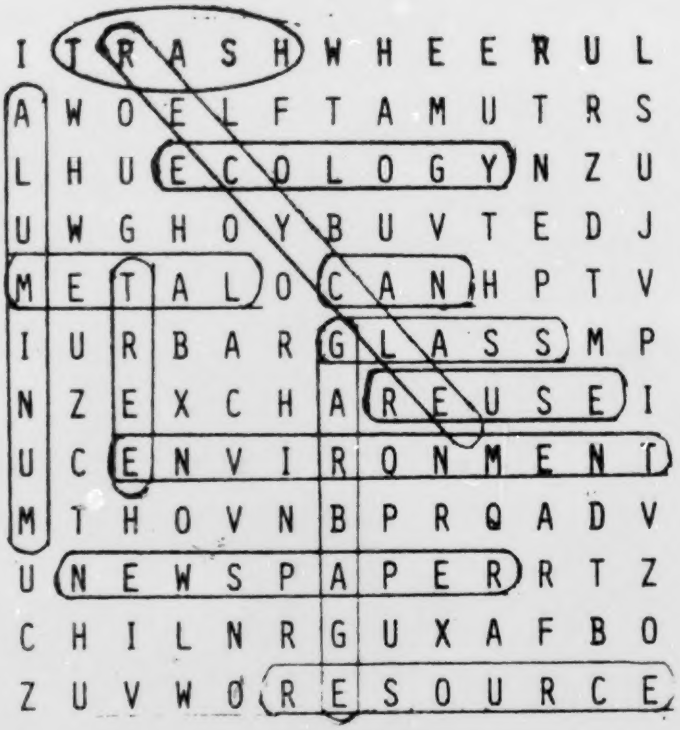
Your crusher will only be as strong as the hinge you use. So the huskier the hinge, the better. Position each hinge plate on the boards as shown in the drawings. (You don't have to take the hinge apart to do this.) Note that the hinge-pin loops extend beyond the board edges. Also, be sure the countersunk screw holes are facing upward.

Mark the hole locations. After drilling the holes, screw the plates in place. Drill five holes down the center of the base board for the lag bolt. Start the holes 7 inches from the hinge end of the board, and space them 1 inch apart. (The purpose of the lag bolt is to prevent the cans from sliding when you apply pressure on the arm.) Put the lag bolt in whatever hole is necessary for the length of the can you're going to crush.



Word Search

Find words that go → ↓ ←



I	T	R	A	S	H	W	H	E	E	R	U	L
A	W	O	E	L	F	T	A	M	U	T	R	S
L	H	U	E	C	O	L	O	G	Y	N	Z	U
U	W	G	H	O	Y	B	U	V	T	E	D	J
M	E	T	A	L	O	C	A	N	H	P	T	V
I	U	R	B	A	R	G	L	A	S	S	M	P
N	Z	E	X	C	H	A	R	E	U	S	E	I
U	C	E	N	V	I	R	O	N	M	E	N	T
M	T	H	O	V	N	B	P	R	Q	A	D	V
U	N	E	W	S	P	A	P	E	R	R	T	Z
C	H	I	L	N	R	G	U	X	A	F	B	O
Z	U	V	W	O	R	E	S	O	U	R	C	E

Words to find:

resource, newspaper, environment, reuse, glass can, garbage, tree, aluminum, ecology, metal, trash, recycle.

ACTIVITY 45

Learning: Much of the litter around our neighborhoods can be recycled.

Materials: Trash bags (large grocery bags will do)

Procedure: As part of this class project, suggest to students that there are several ways that we can improve our environment. Ask for suggestions from them of how *we* can make our school and neighborhood a better place to be. List the suggestions on the chalkboard.

One of the suggestions will probably be to mount a campaign to collect litter. (If this does not come from the children, you may have to suggest it.)

Launch your Anti-Litter Campaign (have students select a name for it) by taking a walk around the school grounds with bags to collect litter.

Bring the litter back to the classroom and take a quick inventory to see what the largest amount of litter is (paper? metal? glass?). Then look for the specific items that are creating the most litter (ice cream wrappers, gum wrappers, etc.).

Have one small group make posters to be placed around the school to make the school population aware of the litter problem at your school.

Have another small group prepare a presentation to be made in each classroom of the school to make students more aware of the litter problem. They may want to target the most frequently discarded item with some special campaign, e.g., have a person near where ice cream is sold to remind children to place wrappers in trash.

Have students (working in teams, pairs, or alone) collect litter in their neighborhood. Again have them identify the most frequently discarded item.

Have all aluminum and paper brought in to be recycled.

Evaluation: After a designated time, assess your recycle campaign:

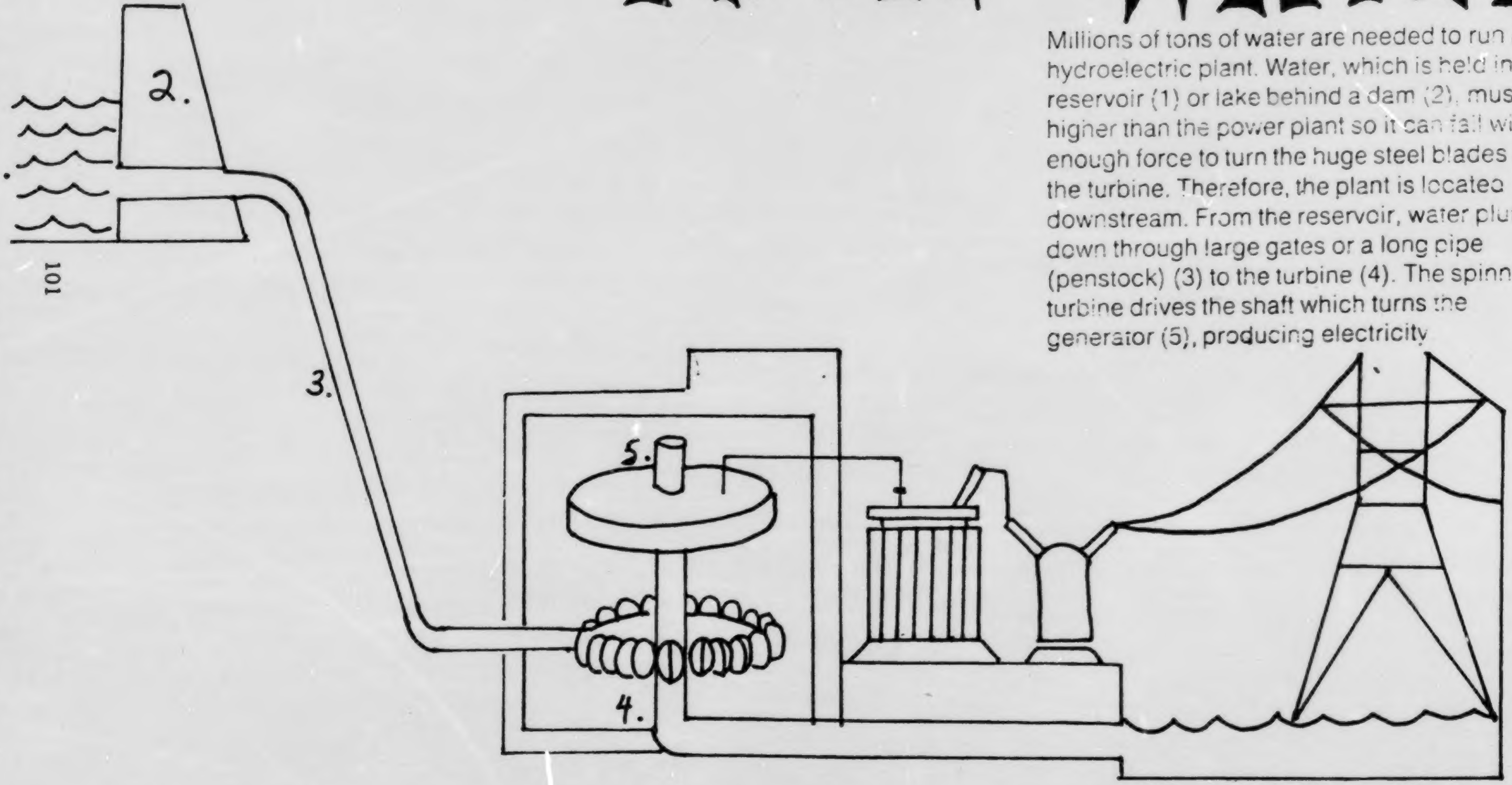
How well did you "sell" the idea to people at school? In the neighborhood?

How do you feel about your efforts in this activity? What can be done to improve it? Should the campaign be continued?

APPENDIX

ELECTRICITY FROM WATER

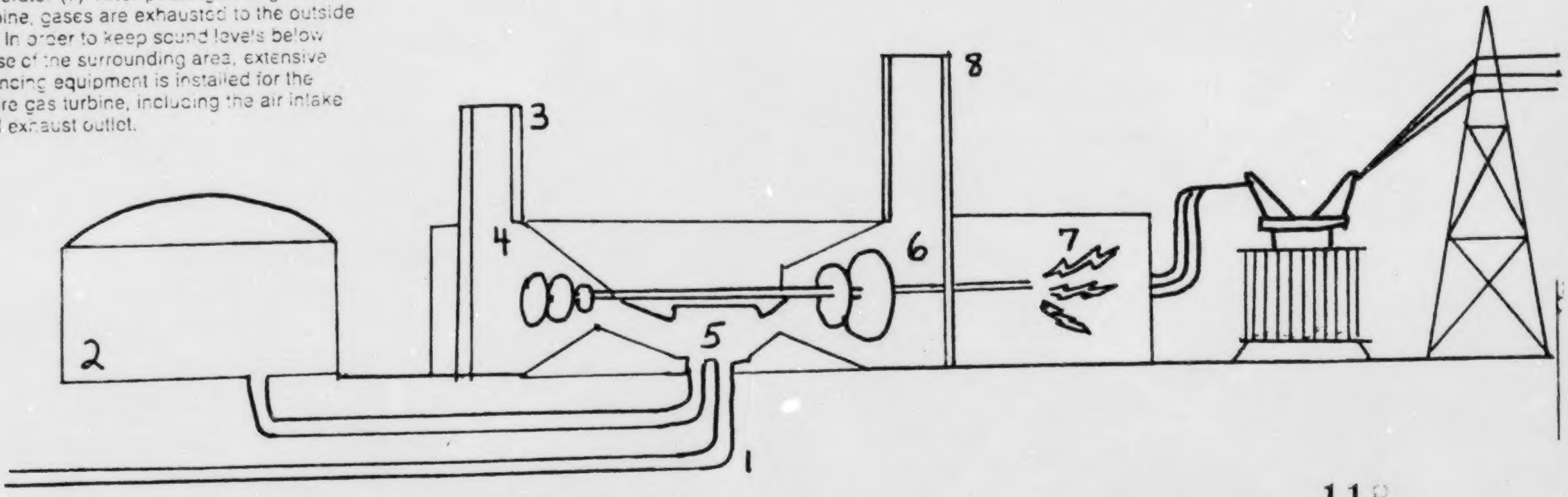
Millions of tons of water are needed to run a hydroelectric plant. Water, which is held in a reservoir (1) or lake behind a dam (2), must be higher than the power plant so it can fall with enough force to turn the huge steel blades of the turbine. Therefore, the plant is located downstream. From the reservoir, water plunges down through large gates or a long pipe (penstock) (3) to the turbine (4). The spinning turbine drives the shaft which turns the generator (5), producing electricity



Appendix A-1

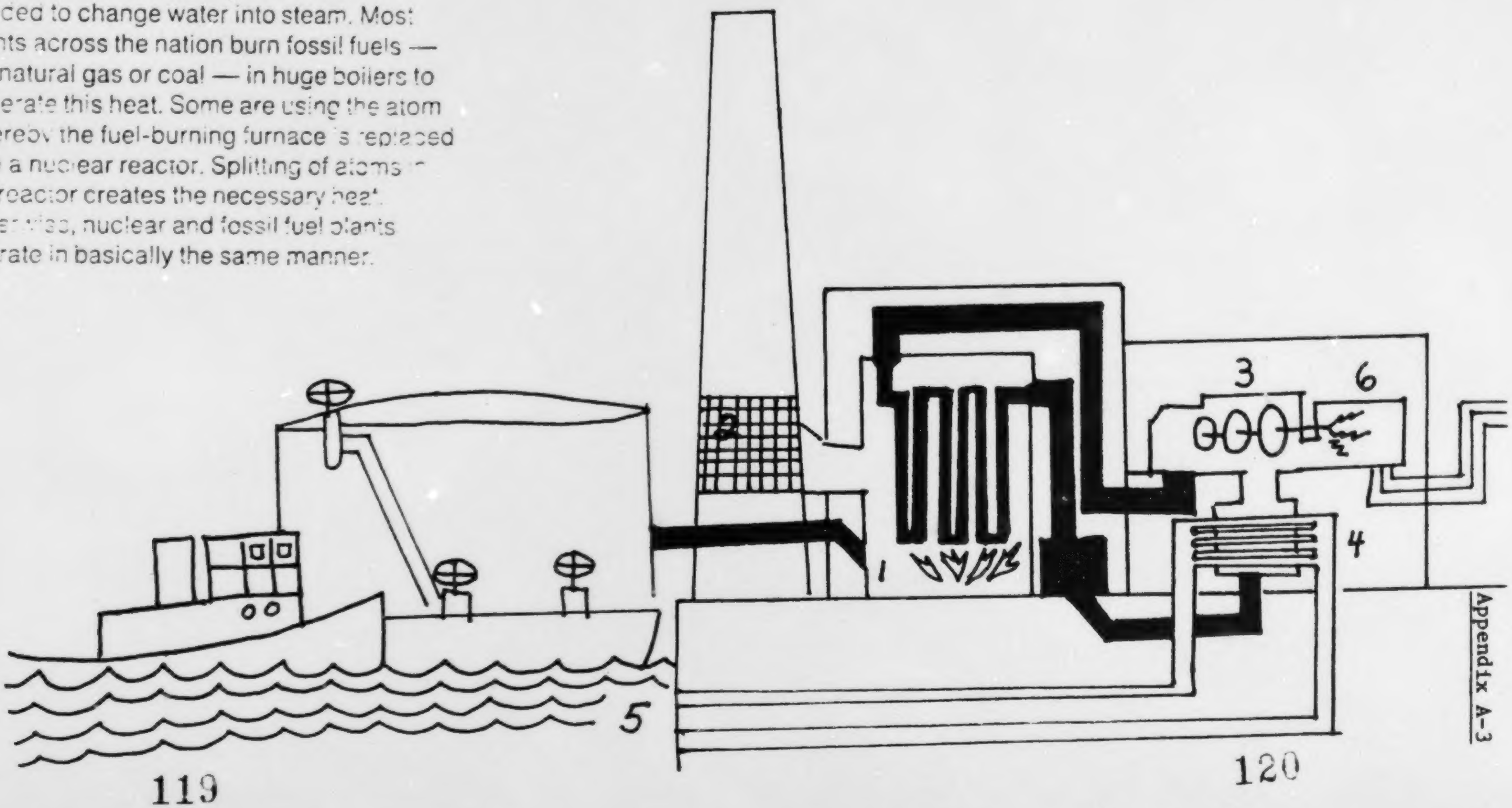
ELECTRICITY FROM GAS TURBINES

A gas turbine burns either natural gas supplied from a pipeline (1) (where available), or low-sulfur household type oil which is delivered by truck or barge and stored in a tank (2). Air, drawn from the outside (3), is compressed (4), and discharged into combustion chambers (5). Here, fuel is added, mixed with the air and burned. Burning process produces high-pressure combustion gases which flow to the turbine (6). Pressure of the gases rotates the turbine, which turns an electric generator (7). After passing through the turbine, gases are exhausted to the outside (8). In order to keep sound levels below those of the surrounding area, extensive silencing equipment is installed for the entire gas turbine, including the air intake and exhaust outlet.

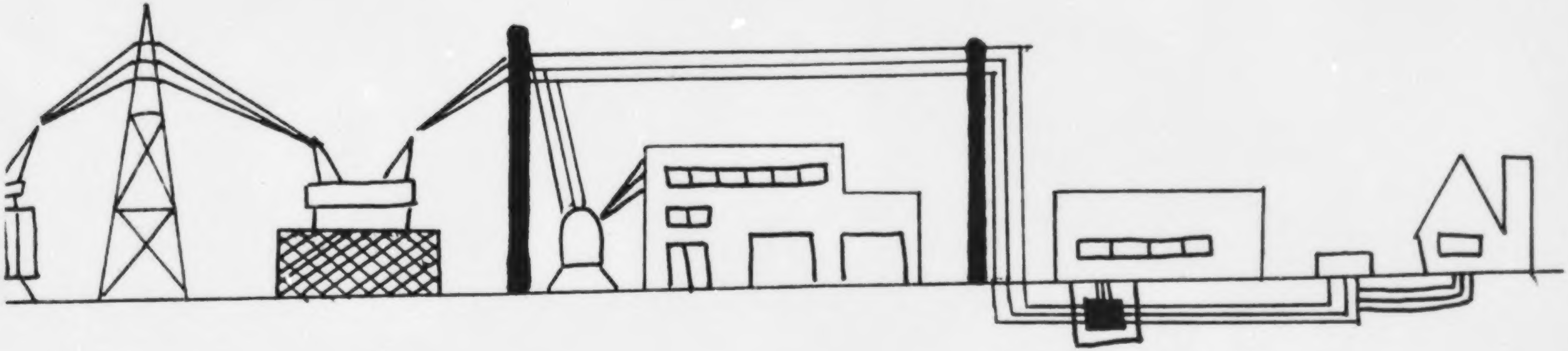


ELECTRICITY FROM FOSSIL FUELS

In steam-electric power plants, heat is needed to change water into steam. Most plants across the nation burn fossil fuels — oil, natural gas or coal — in huge boilers to generate this heat. Some are using the atom whereby the fuel-burning furnace is replaced with a nuclear reactor. Splitting of atoms in the reactor creates the necessary heat. Otherwise, nuclear and fossil fuel plants operate in basically the same manner.



Fuel is delivered to plant and stored in yard Oil or finely powdered (pulverized) coal is blown into the boiler (1) where it burns, giving off intense heat. Water, circulating through miles of tubing in the boiler, absorbs heat from the fire and changes into steam. Ash resulting from the fuel burning in high-pressure boilers is removed from the stack gases by dust collectors (precipitators) (2). This permits clean gases to be released to the atmosphere, thereby reducing air pollution. Steam passes through the turbine (3) and into a condenser (4) where it is cooled and changed back into water as it flows over thousands of tubes. Water is then returned to boiler for reuse in the system. Water to condense steam is drawn from the body of water on which the plant is located (5), pumped through tubes in the condenser and returned to its original source. The turbine consists of a number of rows of blades which, much like spokes on a wheel, stem out from a shaft at the center. Steam acting against these blades, like wind on a windmill, causes the shaft to spin; its exact speed is controlled by a governor. Shaft turns the generator (6) which has two parts: a stationary part, coils of wire (stator); a rotating part, a magnet (rotor). Magnet rotates inside coils of wire. As the magnetic field moves at high speed past the coils of wire, alternating current is generated. Electricity then goes to a substation (7) outside the plant where transformers raise the voltage (*electrical pressure*) high enough to send the power many miles. Large cables (transmission lines) (8) suspended on steel poles or towers carry the current to substations (9). Here the voltage is lowered and electricity is fed into a distribution system (10). Smaller transformers provide proper voltages for industries, stores, homes and farms. After it reaches the customer, electricity goes through a meter which measures the amount being used.



To accompany Activity 6

Appendix A-4

HOW IS ENERGY USED?

Look through newspapers, magazines, school books, library books, and find 10 different kinds of pictures. Write a description of your pictures and tell what form or source of energy is being used (gasoline energy, electrical energy, gas energy, solar energy, steam energy, nuclear energy). Could a picture show more than one energy type?

	Picture Description	Energy Being Used
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

Which type of energy did you see used most often? (Use picture results.)

____

Now add all your energy types to a class graph.

From the class graph, what did you find to be the most used form or source of energy? ________________________

WHAT DOES IT MEAN?

Find these words in the dictionary and write the meaning of each word.

1. resource ____________________
2. fuel ____________________
3. pollute ____________________
4. values ____________________
5. conservation ____________________
6. environmentalist ____________________
7. waste ____________________

Put the words in alphabetical order:

1. ____________________
2. ____________________
3. ____________________
4. ____________________
5. ____________________
6. ____________________
7. ____________________

Write a sentence using as many of the words as you can:

____

____

____

To accompany Activity 10 Appendix A-6

WORDS, WORDS, WORDS

Select 10 energy-related or environment-related words. Look up the definitions for your words. Write your words in the blank spaces that follow:

__________ __________ __________ __________ __________

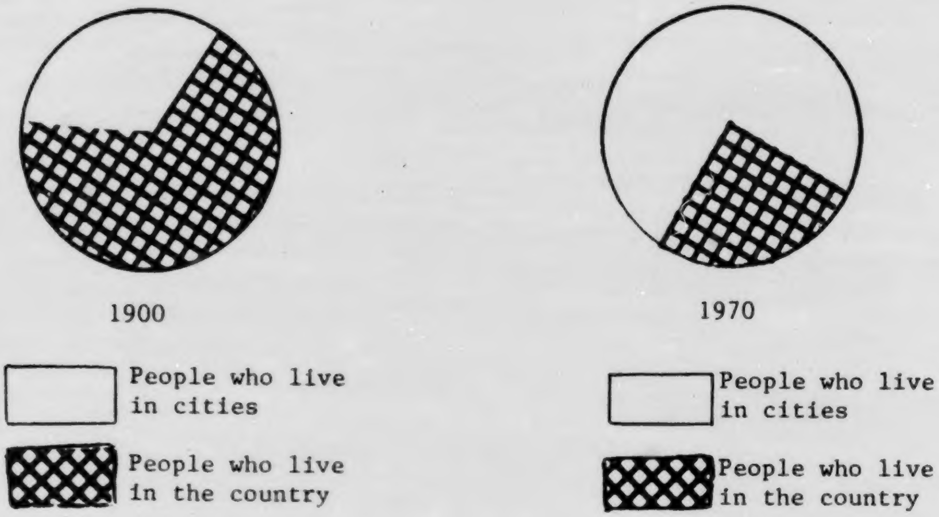
__________ __________ __________ __________ __________

In the spaces below, put all 10 words from your list in alphabetical order, and write a sentence of your own for each word you have selected. (Be sure you read the word meaning.)

1. __________ ____
2. __________ ____
3. __________ ____
4. __________ ____
5. __________ ____
6. __________ ____
7. __________ ____
8. __________ ____
9. __________ ____
10. __________ ____

Select one of your words and find out how many other people in your classroom used the same word. Share your paper with your teacher for a class activity.

CAN YOU READ A PIE?



1. Look at the two graphs. What kind of information do they give you?

____

2. Use the graphs to answer these questions:

In 1900 did more people live in cities or in the country?

____

In 1970 did more people live in cities or in the country?

____

3. How could this cause problems for cities?

____

4. What problems do you think a city would have that a farm would not?

____

5. Why do you think people in the United States have moved into cities from farms? ______________________________________

____

THE STORY OF COAL

A long time ago there were many trees and big plants on the earth. When they died they fell to the ground. Millions of years went by. The trees and plants turned into coal.

Coal has not always been used by people. Farmers saw it when they worked in their fields. Sometimes hunters found pieces of the black rock on the ground. No one thought it could be used for anything.

Then people found uses for coal. People dug down deep into the earth for coal. They began to burn coal. It gave off heat. It could turn iron into steel. It could make a room warm. It could cook food.

Some railroads began to carry coal all over the country. The coal was used in homes and in factories. It was used to make the trains move. The car behind the train engine was filled with coal. A railroad worker shoveled coal into a firebox. The firebox heated water. The hot water made steam. The steam made the train move. People had learned that coal could be used to make steam power and heat. Coal became an important natural resource.

ENVIRONMENTALISTS

People who work to protect America's natural beauty are called environmentalists. They care about our parks and our rivers and our streams. They want to keep parks clean and beautiful so all people can enjoy the out-of-doors.

Environmentalists sometimes start clubs so they can work together. One such club is the Sierra Club. Many different kinds of people belong to the Sierra Club. Boys and girls and men and women from all parts of the country belong to the Sierra Club.

These people work to help everyone see how important it is to save the natural beauty that we have. They work in Washington, D.C., to tell lawmakers about the laws that are needed to help save forests, parks, fields, streams and wild animals. The club hopes these laws will be made so you will have beautiful places to go to when you are grown.

THE MAIN THING

1. What are environmentalists?

____

____

2. What does the first paragraph say? (In your own words, summarize it in *one* sentence.)

____

____

3. What is the Sierra Club?

____

____

4. Why would someone belong to the Sierra Club?

____

____

5. What does the second paragraph say? (In your own words, summarize it in *one* sentence.)

____

____

6. What does the third paragraph say? (In your own words, summarize it in *one* sentence.)

____

____

7. Look at what you have written and find the *main idea* of this reading. Write it in your own words.

____

____

8. Would you want to belong to an environmental club? ____________________

Why? ____

____

To accompany Activity 15 | Appendix A-11

HUMAN ENERGY

Look through a textbook and find at least 10 pictures with people. Write a description of the activities that the people are doing in each picture. Then check whether the people would be using up a high level or a low level of energy.

	Page Number	Picture Description	Energy Cost High	Energy Cost Low
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				

If this paper makes you think hard (which means you are working your brain hard), then you are using up energy. What will you do to replace the used-up energy? How much will it cost? Draw your answers below.

To accompany Activities 16 and 17

Appendix A-12

RESEARCH GUIDE

1. What am I trying to find out? Write it: ______________________

____

____

2. Use the index of books to find page numbers that will give you information. Write them:

____

3. Read the pages. Summarize each page.

____

____

____

____

____

____

____

____

____

4. What is the main idea of what you read?

____

____

5. If there is a picture or a chart that will help explain the information, draw it on a large piece of paper.

6. Think of how you are going to present your ideas to the class so that they will understand what you found.

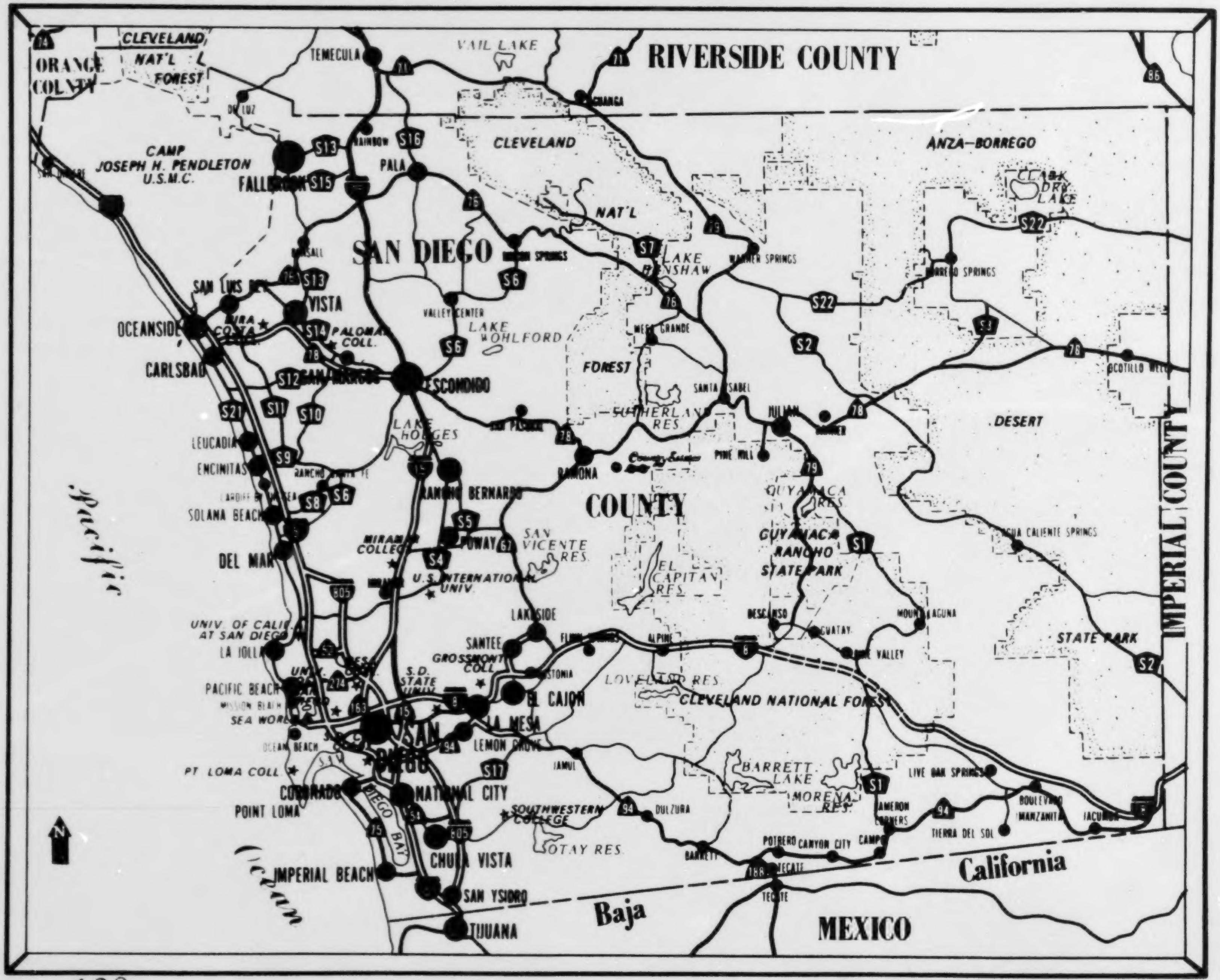
Appendix A-13

MILES PER GALLON CHART

Model	Manufacturer	MPG
Chevette	GM-Chevrolet	36
Civic CVCC	Honda	44
Corolla Sedan	Toyota	32
Datsun B-210	Nissan	42
Datsun 200SX	Nissan	26
Accord CVCC	Honda	42
Celica GT	Toyota	26
Rabbit	Volkswagen	34
Fiat 128	Fiat	27
VW Station Wagon	Volkswagen	28
Opel (Isuzu)	Isuzu	27
Vega	GM-Chevrolet	28
Dodge Colt	Mitsubishi	35
Pinto	Ford	30
Mazda GLC	Toyo Kogyo	38
Mustang II	Ford	26
Datsun 280Z	Nissan	21
Volvo 244	Volvo	22
Gremlin	American Motors	23
Maverick	Ford	24
Volare	Chrysler-Plymouth	20
Nova	GM-Chevrolet	22
LTD II	Ford	17
GTO	GM-Pontiac	17
Trans Am	GM-Pontiac	17
Matador	American Motors	15
Cutlass Supreme	GM-Oldsmobile	18
Cougar	Ford	16
Ford	Ford	15
Buick Electra 225	GM-Buick	18
Plymouth	Chrysler-Plymouth	15
Silver Shadow	Rolls Royce	12
Chrysler	Chrysler-Plymouth	13
Bonneville	GM-Pontiac	17
Eldorado	GM-Cadillac	14
Buick Wagon	GM-Buick	18
Ford Wagon	Ford	13
Chrysler Wagon	Chrysler-Plymouth	12
Continental Mark V	Ford	13
Toronado	GM-Oldsmobile	15
Grand Prix	GM-Pontiac	17
Thunderbird	Ford	17
Mercedes 280 SE	Daimler-Benz	16
Seville	GM-Cadillac	16
Chevy Van V-8	GM-Chevrolet	18
Dodge Van V-8	Chrysler-Dodge	16
Ford Van V-8	Ford	16
VW Bus	Volkswagen	23

January 1977 Gas Mileage from EPA City/Highway Test Cycle. Source: "1977 Gas Mileage Guide for New Car Buyers," U.S. Environmental Protection Agency, January 1977 (Second Edition) Fuel Economy, Pueblo, Colorado 81009.

To accompany Activity 21


RIVERSIDE COUNTY
ORANGE COUNTY
CLEVELAND NAT'L FOREST
TEMECULA
VAIL LAKE
ANZA
DE LUZ
CAMP JOSEPH H. PENDLETON U.S.M.C.
SAN ONOFRE
FALLBROOK
RAINBOW
PALA
CLEVELAND
NAT'L
ANZA-BORREGO
CLARK DRY LAKE
SAN DIEGO
RINCON SPRINGS
LAKE HENSHAW
WARNER SPRINGS
BORREGO SPRINGS
BONSALL
SAN LUIS REY
VISTA
OCEANSIDE
MIRA COSTA COLL.
PALOMAR COLL.
VALLEY CENTER
LAKE WOHLFORD
MESA GRANDE
FOREST
CARLSBAD
SAN MARCOS
ESCONDIDO
SANTA YSABEL
SUTHERLAND RES
JULIAN
BANNER
OCOTILLO WELLS
DESERT
LAKE HODGES
SAN PASQUAL
LEUCADIA
ENCINITAS
RANCHO SANTA FE
RANCHO BERNARDO
RAMONA
PINE HILLS
CARDIFF BY THE SEA
SOLANA BEACH
COUNTY
CUYAMACA RES
DEL MAR
MIRAMAR COLLEGE
POWAY
SAN VICENTE RES.
CUYAMACA RANCHO STATE PARK
AGUA CALIENTE SPRINGS
MIRAMAR
U.S. INTERNATIONAL UNIV.
EL CAPITAN RES.
IMPERIAL COUNTY
UNIV. OF CALIF. AT SAN DIEGO
LAKESIDE
DESCANSO
MOUNT LAGUNA
LA JOLLA
SANTEE
FLINN SPRINGS
ALPINE
GUATAY
STATE PARK
GROSSMONT COLL.
PINE VALLEY
PACIFIC BEACH
MISSION BEACH
UNIV. OF SAN DIEGO
S.D. STATE UNIV.
ALTONIA
LOVELAND RES.
EL CAJON
CLEVELAND NATIONAL FOREST
SEA WORLD
LA MESA
OCEAN BEACH
SAN DIEGO
LEMON GROVE
JAMUL
PT. LOMA COLL.
BARRETT LAKE
MORENA RES.
LIVE OAK SPRINGS
CORONADO
NATIONAL CITY
CAMERON CORNERS
BOULEVARD
MANZANITA
JACUMBA
POINT LOMA
SAN DIEGO BAY
SOUTHWESTERN COLLEGE
DULZURA
TIERRA DEL SOL
CHULA VISTA
OTAY RES.
BARRETT
POTRERO
CAMPO
CANYON CITY
IMPERIAL BEACH
TECATE
California
SAN YSIDRO
Baja
TIJUANA
MEXICO
Pacific Ocean
N
5
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S16
S17
S21
S22

Appendix A-14

PETROLEUM PRODUCTS

List 10 products that are made from petroleum in the spaces below:

1. ________ 2. ________ 3. ________ 4. ________ 5. ________

6. ________ 7. ________ 8. ________ 9. ________ 10. ________

Now that you know the names of 10 different products that are made from petroleum, pick any five products and write them down below. Look them up in the dictionary and write what you find out about them. Could you find or bring in an example of one of the products that you have recorded on this sheet?

Product	Information I Found in the Dictionary
1.	
2.	
3.	
4.	
5.	

What product do you use most? ________________________________

What product do you use least? ________________________________

List the products that we could use something else in place of. Tell what could be used instead that would not use oil.

ECOLOGY-RELATED JOB DESCRIPTIONS

Meterologist. Studies changes in the earth's atmosphere. Collection of weather data is a key job of a meterologist. Air pollution is a basic problem also studied by a meterologist. Requirements: 4 years of college and at least one year of graduate school.

Oceanographer. Examines the ocean, its contents, and movements. Looks for new ways to solve environmental problems connected with the ocean.

Sociologist. Studies people and groups of people. Looks at organizations and the environment in which they live. Requirements: 5-7 years of college including graduate school.

Writer. Informs citizens about ecology and how it affects their daily lives. Looks for solution to ecology problems.

Lawyer. Studies and helps create laws to protect the environment. Requirements: 7 years of college including law school.

Physiologist. Studies animals, organs, tissues, and cells. Studies the processes as they relate to environmental problems. Requirements: 5-7 years of college including graduate school.

Epidemiologist. Studies diseases of human. Interest in the environmental balance between disease carriers and their natural predators. Requirements: 10 years of study including college and medical school.

Geologist. Studies the earth's crust, its structure and composition. The geologist is a key to understanding the use of the environment. S/He looks for energy sources such as oil and natural gas. Requirements: 4-7 years of college and graduate school.

Toxicologist. Looks for poisonous substances in environmental areas. Requirements: 5-7 years of college and graduate school.

Urban Planner. Examines urban problems, works with agencies to prevent and solve urban connected problems. Checks the needs of the city as related to the environment.

Soil Conservationist. Works with farmers and other interested groups in the management, use, and care of soil. Works closely with environmental problems related to land use. Requirements: 4 years of college.

Aquatic Biologist. Studies the plant and animal life underwater. Interested in maintaining the balance of life underwater. Requirements: 5-7 years of study including college and graduate school.

Entomologist. Studies insects and how they affect other forms of life. Specializes in insects that carry disease or spoil food. Requirements: 5-7 years of college including graduate school.

Teacher. Educates and introduces individuals to the problems and responsibilities of the environment. Creates environmental awareness and motivates individuals to work on solving these problems. Requirements: 5 years of college.

Environmental Engineer. Uses the concepts of engineering to provide methods and ways to solve the problems of ecology. Covers all areas of air, water, noise, health, social, and economic interactions. Requirements: 4 or more year of college.

Physician. Cares for and treats individuals who suffer from the ill effects of an unhealthy environment. S/He not only works with diseases, but also checks safety and the effects on health of environmental pollutants. Requirements: 8 years of study including college, medical school, and internship.

Sanitarian. Manages programs and monitors accountability related to sanitation practices. Checks health standards to prevent outbreaks of illness. Enforces laws regarding handling and preparing of food for public use. Requirements: 4 years of college.

Solid-Waste Systems Supervisor. Supervises solid-waste collection, processing, and disposal systems. Requirements: 1 or 2 years of technical or vocational training.

Environmental Inspector. Checks and records environmental purity of air, smoke, water, and waste by using mechanical and chemical tests. Checks data and notifies the agency which is responsible for seeing to it that environmental standards are met. Requirements: 2-3 years of technical school or college.

Nuclear Technician. Tests nuclear waste disposal methods. Reports and assists in the development of machines and equipment. Works at nuclear power plants in the detection of radiation. Uses complex laboratory equipment. Requirements: 2-3 years of technical school or college.

Mechanical Tester. Checks air and noise pollution caused by engines. Monitors fuels and lubricants in engines and analyzes engine exhausts. Requirements: 2-3 years of technical school or college.

Incinerator Plant Attendant. Job responsiblities are to arrange for waste disposal in such a way as to minimize air pollution. Operates an incinerator, manages unloading solid-waste trucks. Fixes and maintains machines. Requirements: High school education and on-the-job training.

Wildlife Attendant. Works and operates fish hatcheries, refuge parks, and animal conservation areas. Watches animal development including breeding counts, and studies of fish, insects, birds, and other animals in their natural habitats. Requirements: High school education and on-the-job training.

Waste Water Treatment Plant Operator. Performs job that concerns the effective recycling of water and the removal and disposition of solid wastes. Works with specialized water pollution control equipment, i.e., takes readings, recordings, and samples of waste water. Requirements: High school education and on-the-job training.

ENERGY-RELATED JOB DESCRIPTIONS

Conservation Analyst. Reviews technical and engineering literature for new energy developments that would save customers money. Education: Prefer a college degree in Engineering or Economics.

Conservation Equipment Coordinator. Coordinates the sale of conservation products such as water saving shower heads, water heater blankets, and home insulation. Education: Prefer a college degree in Marketing or Business Administration.

Conservation Systems Engineer. Plans and develops energy conservation programs related to the design of company's electric distribution system. Education: Prefer a college degree in Electrical Engineering.

Consumer Affairs Counselor. Monitors changes in customers' attitudes and wants concerning the company. Education: Prefer a college degree in Business Administration or Public Relations.

Energy Advisor. Provides energy conservation and consumer product information to residential and commercial customers. Also assists residential and commercial customers in selecting efficient and economical appliances. Frequently travels throughout the community to conduct energy information programs to interested groups. Education: Prefer a college degree in Marketing or Business Administration.

Energy Utilization Engineer. Studies and recommends existing and potential use of energy by industrial and commercial customers. Education: Prefer a college degree in Engineering or Marketing.

Environmental Specialist. Develops, monitors, and coordinates company air quality programs for fossil and geothermal generating facilities. Education: Prefer a college degree in Meteorology or in Engineering, Chemistry, or Physics with specialization in Meteorology.

Farm Management Coordinator. Monitors and oversees the use of company farm lands, and informs the agricultural community regarding company land use plans. Education: Prefer courses in Real Estate and Agricultural Science.

Field Sales Representative. Provides assistance to industrial, commercial, and governmental customers concerning most efficient use of energy. Education: Prefer a college degree in Marketing, Business Administration, or Engineering.

Land Planner. Conducts land use and environmental impact studies. Meets with local governmental agencies and community groups concerning environmental regulations. Education: Prefer a college degree in Urban Planning, Environmental Studies, Civil Engineering, or Public Administration.

Sanitary Landfill Equipment Operator. Drives a gasoline or diesel powered tractor, power shovel, or other heavy equipment for the maintenance of a sanitary land fill. Requirements: Some high school education and on-the-job training.

THINKING ABOUT JOBS

Make a list of six different jobs that have something to do with energy and/or the environment.

1. ____________________ 4. ____________________

2. ____________________ 5. ____________________

3. ____________________ 6. ____________________

Write down the job you like best: ______________________________

Write two reasons you might like this job:

1. ____
____

2. ____
____

What would you be doing to help our environment if you did this job? _____
____
____

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Dear ____________________:

Our class is learning about energy. As part of our work, I need to find out what energy policies we have in our home. I would also like to help make a new energy policy for our home.

I. Rules to conserve energy we already have in our home:

____

____

____

II. Some rules to conserve energy we could have:

____

____

____

III. A new energy policy we are all willing to adopt:

____

____

____

Signed by all members of family

____

____

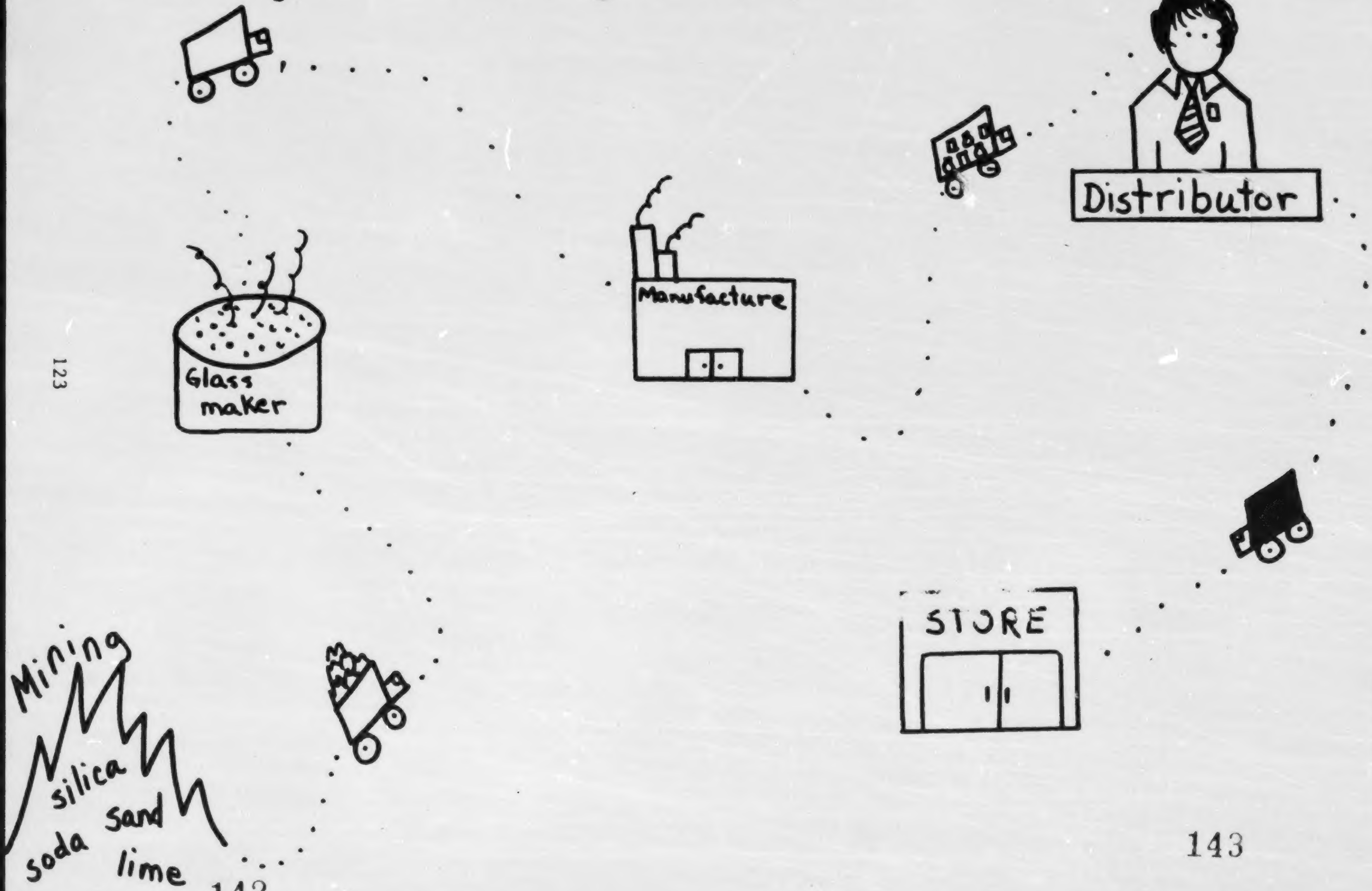
____

____

____

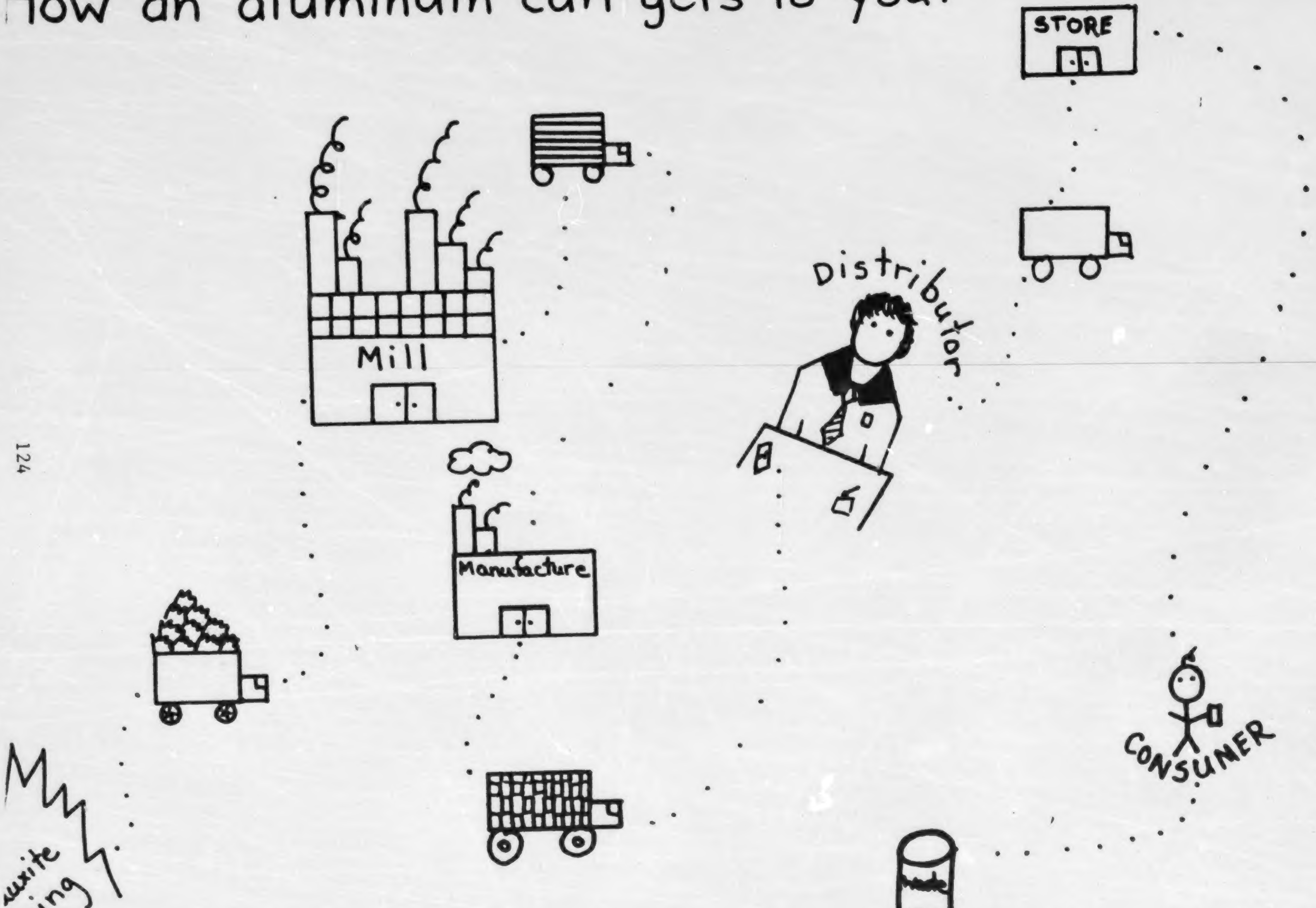
How a glass bottle gets to you.

To accompany Activity 42


Mining
silica
sand
soda
lime
Glass maker
Manufacture
Distributor
STORE

Appendix A-20

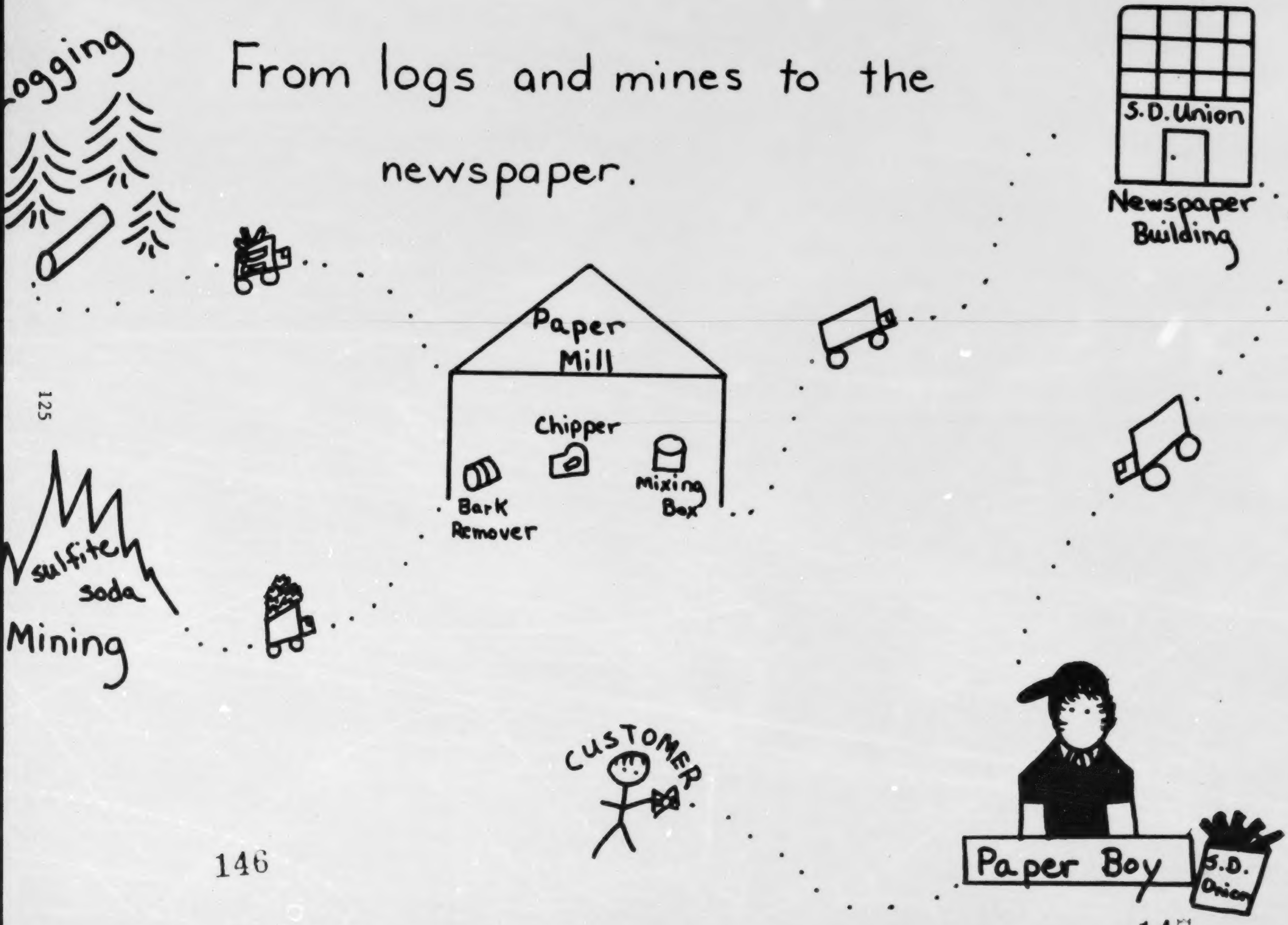
How an aluminum can gets to you.


STORE
Distributor
Mill
Manufacture
CONSUMER
uxite
mining

To accompany Activity 42

To accompany Activity 42

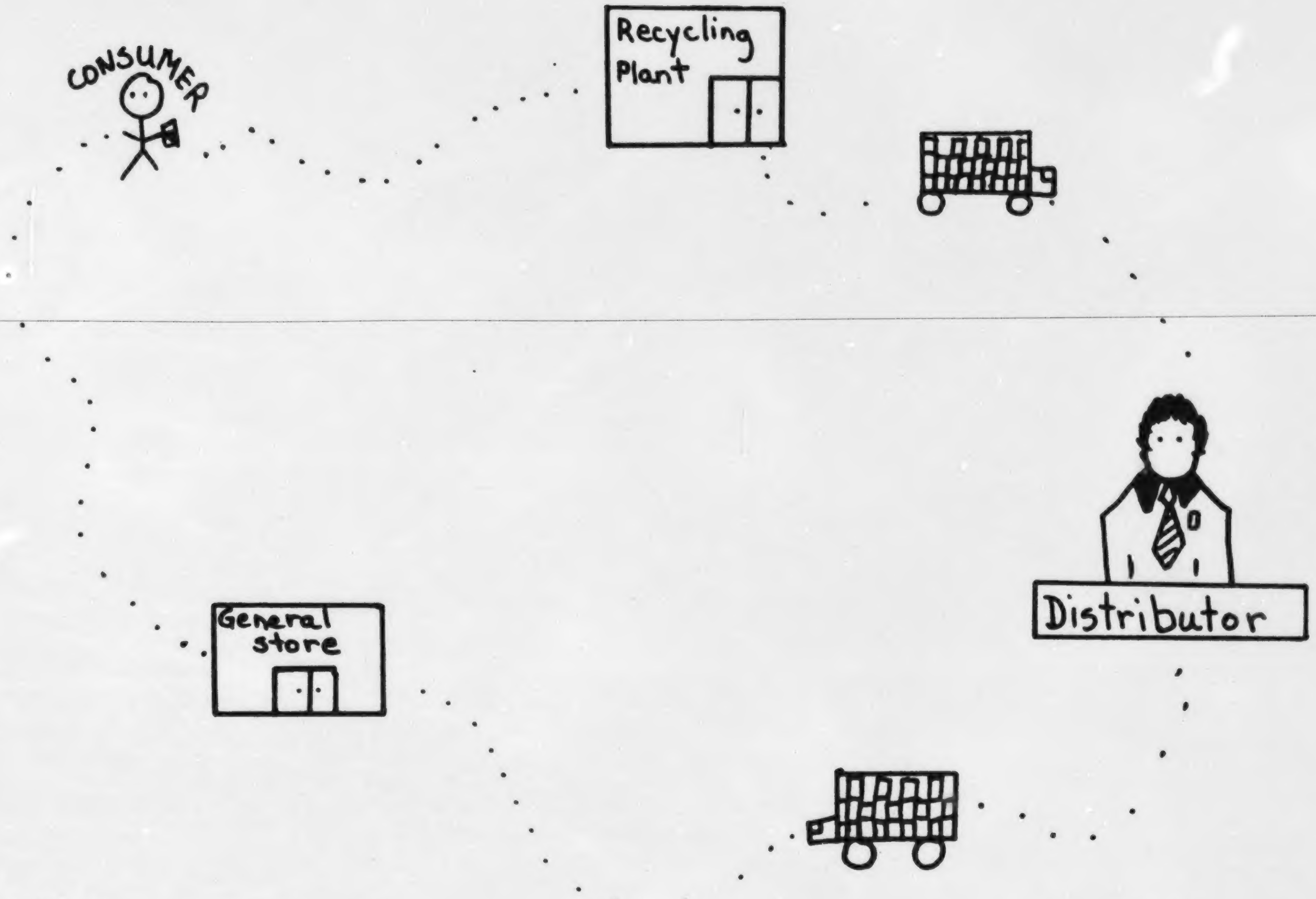
From logs and mines to the newspaper.


Logging
Newspaper Building
S.D. Union
Paper Mill
Chipper
Bark Remover
Mixing Box
sulfite
soda
Mining
CUSTOMER
Paper Boy
S.D. Union

Appendix A-22

Recycling saves energy and resources.

To accompany Activity 42

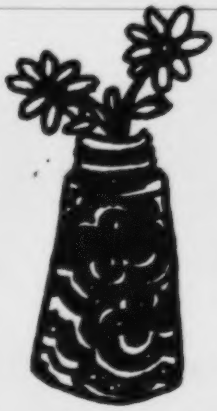

CONSUMER
Recycling Plant
Distributor
General store

Learning: Throwing away a disposable item is wasting energy.

Materials: Plastic bottle for demonstration, extra disposable items for children who fail to bring in items, manila paper 12" x 18", crayons, pencils.

Procedure: Ask the class a day prior to this activity to bring in things their family uses once and then discards (cans, bottles, newspapers, styrofoam items, paper plates, paper towels, etc.).

Have the students share the items they brought in and their uses. Recall with the class that it takes energy to make these things. Ask how they feel about using energy to make something that is used only once and is then thrown away.



Show the class your item--a plastic bottle (bleach bottle, drinking water bottle). On the chalkboard list the materials and forms of energy it took to make the bottle.

Comment that it seems a shame to throw it away. Together with the class think of another use for this bottle.

Evaluation: Have children invent a new use for the item they brought in.

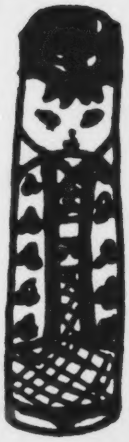
Make a "Recycling Energy" exhibit using the class' inventions. Children should write a short description of the item's new use to accompany the item in the exhibit.

Note: Some children may not be able to physically remodel the item to demonstrate its new use. Allow this child to illustrate the item's new use. The item can accompany the picture and a written description of the new application.

An extended activity for Activity 42

Learning: We help our environment by making permanent use of throwaway materials.

Materials: Throwaway materials from home; other materials as needed by children.



Teacher Information: Have the children save all of the throwaways from their families (except wet garbage) for two days and bring them into class.

Procedure: If newspapers or aluminum cans or trays are brought in, put all of these into a common pile to be taken to a recycling center. Stress the fact that we help the environment and save energy by recycling these materials.

Have each child separate the rest of his/her throwaways into piles according to what the items are.

Make a list on the chalkboard or draw a chart of all the materials that have been brought in.

Let the children brainstorm ways they can use these materials for art projects. List all ideas on a chart or the chalkboard.

Allow each child to attempt to carry out one of these ideas in his/her own way.

Evaluation: Did each child produce something that he/she was pleased with and wanted to keep? Stress the fact that they are helping the environment by turning their throwaways into something to keep and enjoy.

Some possible projects:

small spice cans ← rattles
large paper bags ← over-the-head masks
small paper bags ← puppets
metal hangers ← metal sculpture
styrofoam ← styrofoam printing plates, styrofoam sculpture
cans ← pencil holders
cardboard tubes ← people, totem poles, kokeshi dolls, puppets
boxes ← box sculpture, cardboard toys
bottles and jars ← vases
eggshells ← mosaics, flowers

To accompany Activity 43

Appendix A-26

SAN DIEGO
ECOLOGY
CENTRE, INC.
340 Kalmia St.
San Diego, Calif. 92101
Phone: (714) 235-0066

RECYCLING LIST

Revised April, 1978

RECYCLING CENTERS

Operated by the San Diego Ecology Centre
Call 235-0066

Chollas Recycling Center
5851 College Grove Drive
Glass, bi-metal, newspapers, oil

Del Mar Recycling Center
N.E. corner Jimmy Durante &
San Dieguito Dr., Glass,
aluminum cans, newspapers

Rose Canyon Recycling Center
3775 Morena Blvd.
Glass and aluminum cans

A-1 Paper Recycling Center
3330 Broad Ave., San Diego-232-2363
801 W. Main St., El Cajon - Sat.8-12
Oceanside/Carlsbad-Plaza&College-Sat.8-2
Newspapers & Aluminum cans

Girls Scouts - San Diego Imperial
Council, Inc. - 298-8391
1231 Upas St. - newspapers, aluminum
cans, bi-metal cans, glass.

North Coast Family Y.M.C.A.-753-6536
200 Saxony Road, Encinitas
newspapers, aluminum cans

Ocean Beach Community Services
Recycling Center - 225-9305
5041 Newport Ave.
White office paper, aluminum cans

Community Hospital of Chula Vista
751 Dora Lane, Chula Vista
newspapers, aluminum cans
Mrs. Marylou Goodell - 420-1358

Recycling Center - 231-2521
2744 Newton St. - newspapers, glass,
aluminum and bi-metal cans

PAPER

Newspaper: See Yellow Pages under "Waste Paper" for companies that purchase newspapers.

The San Diego Newspaper Recycling Program provides pick-up of separately bundled or bagged newspapers (7am-5pm) from curbs and alleys throughout the city, every week on regular city trash pickup days. They must be readily seen from the street. For information call: 236-5661. Call:236-5906 request/pickup

For further information regarding newspaper recycling bins located throughout the San Diego region call San Diego Ecology Centre, 235-0066 or Kiwanis Club, 278-6061.

Office Paper: The San Diego Ecology Centre provides free pickup of high quality office paper (bond, computer paper and cards, etc.) For more information call 235-0066.

Cardboard: See Yellow Pages under "Waste Paper".

Most supermarkets that have a bailing machine will accept heavy, non-slick type cardboard.

Magazines: Due to clay content most are useless for recycling. They can be used by senior citizens' clubs, beauty shops, barber shops, convalescent homes, schools, etc. Check local Goodwill Industries and thrift shops. Libraries need certain issues for reference material.

Misc. Paper: Check Yellow Pages under "Waste Paper". Most paper has some value. You can sell letters, pamphlets (not shiny paper), IBM paper and cards. You cannot sell carbon paper, magazines, single layered boxes or cereal cartons.

GLASS

No window glass. Jars and bottles accepted. Labels need not be removed.

Glass Recycling Centers

Chollas Recycling Center - 235-0066
5851 College Grove Drive
8am-5pm except holidays

Rose Canyon Recycling Center-235-0066
3775 Morena Blvd.
24 hours-7 days a week

Girls Scouts - 298-8391
1231 Upas St.
8am-4:30pm; Mon-Fri.

Del Mar Recycling Center-235-0066
N.E. Corner Jimmy Durante Blvd.
and San Dieguito Drive
24 hours; every day.
Pay for aluminum Sat. 10-2pm.

Rancho Bernardo Recycling Center
W. Rancho Bernardo Rd. - 487-6608
(parking lot adjacent to Westwood
Shell Station) Aluminum donations
accepted.

Lake Murray Recycling Center-461-3750
Entrance to Lake Murray, off Lake
Murray Blvd. between Maryland Blvd.
and Highway 8. 24 hours; every day.

METAL

Alcoa, Yes We Can, 111 Elm, Suite 303
San Diego - 236-0126
Cans and TV trays accepted.

Reynolds Aluminum Recycling Co.-280-9545
4460 University Avenue

For location and time of pickup in your neighborhood, call the above or San Diego Ecology Centre - 235-0066.

Del Mar Recycling Center
Jimmy Durante Blvd. & San Dieguito Blvd.
Aluminum only.

North Coast Family Y.M.C.A.-753-6536
200 Saxony Rd., Encinitas
Aluminum & bi-metal cans
8am-9pm - every day.

Girl Scouts - 298-8391
1231 Upas St.
Aluminum & bi-metal cans
8am-4:40pm - Mon-Fri.

Recycling Center - 2744 Newton St.
Aluminum, bi-metal cans, heavy metal.

Metal Clothes Hangers: Check dry cleaners

Mercury Batteries: Used in power hearing aids, camera light meters, watches, etc.
McGirr's Jewelers, 3974 Clairemont
Mesa Blvd. N. Clairemont Square

ORGANIC MATERIAL

You can bury waste in a deep hole and wait for it to decompose or you can compost it by mixing it with other substances. There are many good books on the subject at your bookstore or library.

MISCELLANEOUS

Grease: See Yellow Pages under "Rendering Companies". Some will buy kitchen grease and supply a collection barrel for clubs, church groups, etc.

All Von's Markets will buy kitchen grease. Do not put in glass container.

Oil: Nelco Oil Refining Corp., 600 W.12 St. 474-7511, will pick up large quantities of oil. No charge if you take oil to plant.

Call Ecology Centre, 235-0066 for nearest Oil Recycling Center in your neighborhood.

Rags: See Yellow Pages under "Rags". Check local print shops, newspapers and schools.

Junk Cars: Want-ads. Yellow Pages under "Scrap Metal".

Scrap Craft Centers: Clean meat trays, jar lids, containers, cartons, string, buttons, etc. needed for projects. Check with schools, art classes, youth groups, churches, etc.

PRINTED THRU THE COURTESY OF:

Paper Cube Co.
931 East Harbor Drive
San Diego, CA
233-5209

Specializing in newspaper drives for schools, churches and clubs.

Top prices paid.

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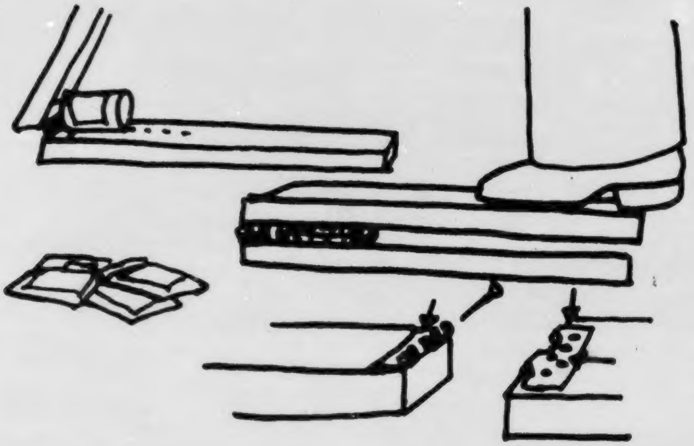
BUILDING A CAN CRUSHER

Materials: 2 feet of "two by six" lumber, 2 feet of "two by four" lumber, heavy duty door hinge, 6 flat-head hinge screws 1½" long, 1 lag bolt ¼" x 1½" long.

Your crusher will only be as strong as the hinge you use. So the huskier the hinge, the better. Position each hinge plate on the boards as shown in the drawings. (You don't have to take the hinge apart to do this.) Note that the hinge-pin loops extend beyond the board edges. Also, be sure the countersunk screw holes are facing upward.

Mark the hole locations. After drilling the holes, screw the plates in place. Drill five holes down the center of the base board for the lag bolt. Start the holes 7 inches from the hinge end of the board, and space them 1 inch apart. (The purpose of the lag bolt is to prevent the cans from sliding when you apply pressure on the arm.) Put the lag bolt in whatever hole is necessary for the length of the can you're going to crush.



To accompany Activity 44

Appendix A-28

Word Search

Find words that go → ↓ ←

I	T	R	A	S	H	W	H	E	E	R	U	L
A	W	O	E	L	F	T	A	M	U	T	R	S
L	H	U	E	C	O	L	O	G	Y	N	Z	U
U	W	G	H	O	Y	B	U	V	T	E	D	J
M	E	T	A	L	O	C	A	N	H	P	T	V
I	U	R	B	A	R	G	L	A	S	S	M	P
N	Z	E	X	C	H	A	R	E	U	S	E	I
U	C	E	N	V	I	R	O	N	M	E	N	T
M	T	H	O	V	N	B	P	R	Q	A	D	V
U	N	E	W	S	P	A	P	E	R	R	T	Z
C	H	I	L	N	R	G	U	X	A	F	B	O
Z	U	V	W	O	R	E	S	O	U	R	C	E

Words to find:

resource, newspaper, environment, reuse, glass

can, garbage, tree, aluminum, ecology, metal,

trash, recycle.

Appendix B

SAN DIEGO CITY/COUNTY SCHOOLS ENERGY EDUCATION COMMITTEE
6401 Linda Vista Road, San Diego, Ca 92111 (714) 292-3641

Ms Judith Adams
Coordinator Science Office
KPBS TV
Dr Robert A Dean
Curriculum Coordinator
Science
Department of Education
Dr M Ted Dixon
Superintendent of Schools
Department of Education
Ms Molly Jean Featheringill
Executive Director
San Diego Ecology Centre
Mr Douglas M Fouquet
Coordinator Community Relations
General Atomic Company
Mr Clifford T Fredrickson
Science Specialist
San Diego City Schools
Dr Thomas L Goodman
Superintendent of Schools
Secretary Board of Education
San Diego City Schools
Mr John E Hamrick
Vice President Marketing
San Diego Gas & Electric Company
Dr Roy E Harris
Social Studies Specialist
San Diego City Schools
Mr Otto A Hirr
Assistant to the President
San Diego Gas & Electric Company
Mr Archie P Kelley
San Diego Representative
ERDA
Mr Edward Kimura
Sierra Club
Mr Nicholas R King
Curriculum Resource Teacher
San Diego City Schools
Dr Jeffrey W Kirsch
Director Science Office
KPBS TV
Mrs Jimmie L Martinez
Consultant Elementary Social Studies
San Diego City Schools
Ms Gail P MacLaughlin
Assistant Director Public Relations
San Diego Gas & Electric Company
Mrs Melanie Messer
Consultant to the
Department of Education
Mr Robert R Miller
Energy Administrator
Rohr Industries
Mr Robert E Morris
President
San Diego Gas & Electric
Dr Edward J Neuner
Professor Economics
San Diego State University
Mr William H Pettus
Energy Management Coordinator
University of California, San Diego
Mr. Ernest J. Roberson
Public Relations Supervisor
San Diego Gas & Electric Company
Mr Rudolph J Schafer
Consultant Conservation Education
State Department of Education
Dr Gilbert E Stuvé
Curriculum Coordinator –
Social Science
Department of Education
Mr John Sullivan
Curriculum Resource Teacher
Elementary Science
San Diego City Schools
Mr. Philip Vermeulen
Conservation Division
California State Energy Commission

Mr. John K. Gessel
Committee Coordinator
Director, School—Community Services
Department of Education

MARCH 1977

GOALS AND OBJECTIVES FOR ENERGY EDUCATION IN SAN DIEGO COUNTY

All students attending the primary, elementary, and secondary schools in San Diego City and County need to know that modern civilization is dependent upon vast amounts of energy to drive the wheels of industry, agriculture, transportation, and to provide people with warmth to protect their health and welfare.

Because the flow of energy into and within the United States is under jeopardy, the San Diego City/County Schools Energy Education Committee was formed in the spring of 1975 to bring to teachers' attention the problems our country is confronted with concerning energy supply and demand.

The committee is dedicated to motivating teachers to help their students learn there are challenges ahead of them to overcome these energy problems. In order to help this process, the committee has developed this set of energy education goals and objectives as its guideline for developing conferences, curriculum materials, and inservice workshops.

The goals and objectives are divided into two parts. Part I contains three program goals which are background for, and in support of, the five student goals which make up Part II of the document. The program goals are stated without accompanying objectives, but the student goals do have objectives that delineate what learners should accommodate and assimilate as part of their body of knowledge.

There are two ideas that permeate the goals and objectives: first, the concept that energy and environment are interwoven is expressed as "energy/environment," and second, as these goals and objectives are implemented, as many local examples as possible will be used to illustrate the objectives.

PROGRAM GOALS

Goal Number 1:

A Balanced Energy/Environment Education Program Will Be Developed

The entire spectrum of pro and contra arguments for individual issues needs to be presented so that the student who become future decision makers are making judgments based upon a complete and not a partial picture of the problem; these students must have adequate information on all aspects of the situation, and should be helped to develop the skills and techniques of information analysis and decision-making. Programs that are developed for the public schools will be reviewed by a subcommittee of the San Diego City/County Schools Energy Education Committee.

Goal Number 2:

An Historical Background of the Energy Problem for Teachers Is Needed

Teachers should understand what energy is, where it comes from, and how its form is changed; that there have been several transitions from one major form of energy utilization to another during the history of man; that we are now living through such a transition; that the transitions have been accompanied by technological developments which may provide an insight on how the present problems can be overcome.

Goal Number 3:

An Array of Educational Delivery Systems Must Be Maintained

Materials, both printed and audio-visual, must be produced, and whatever is published must be properly introduced to teachers through inservice programs about how to use the materials with their students; speakers' bureaus, conferences, workshops, clearinghouses, television, mass media, industrial tours, and semester courses all must be used to disseminate information.

STUDENT GOALS AND OBJECTIVES

Goal Number 1:

Identifying Past, Present, and Alternative Sources of Energy

More than identifying the sources, students should understand what energy is and that workable solutions may come from new, more efficient methods of converting known sources of energy into usable forms of energy and what the trade-offs are for utilizing each of the various energy forms.

Objectives:

1. Students will gain a basic, simplified understanding of technology as it relates to energy.
   - a. Define *energy, work, power, force, heat, fuel, combustion, fission, fusion, photoelectricity.*
   - b. Know the laws of thermodynamics and recognize the fallacy of perpetual motion machines.
   - c. Know commonly used units such as *BTU, kilowatt, kilowatt hour, horsepower, therm, ton, barrel*, etc.
2. Students will gain an historical perspective on alternative sources of energy.
   - a. Transition from one energy epoch to another.
   - b. Reasons why the next epoch became the viable one.
   - c. Identify where each major society presently is on the energy epoch spectrum in terms of how much they consume and produce, and how that affects their lifestyles.
   - d. Outline the choices for bridging this particular transition.
3. Students will be aware of present alternative sources of energy and the consequences of each.
   - a. Types of energy sources; energy mix of the United States and the world.
   - b. Cost/efficiency of energy conversion of end uses.
   - c. Renewable vs. nonrenewable sources.
   - d. Environmental concerns.

4. Students will be aware of future alternative sources of energy and the consequences of each.

   a. Types of energy sources.

   b. Cost/efficiency of energy conversion to end uses.

   c. Renewable vs. nonrenewable sources.

   d. Environmental concerns.

   e. Encouragement for developing new processes and products.

   f. Knowing about career opportunities.

Goal Number 2:

Conservation of Energy is an Important Immediate Necessity

To help our nation more effectively utilize its limited energy resources, we will have to resort to several forms of conservation including turning off lights, insulating buildings, driving more efficient cars, and many other methods; some will be voluntary and others will be mandatory; conservation should be viewed as another "source" of energy in the sense that energy which was previously wasted can be productively used to meet needs elsewhere in the economy.

Objectives:

1. Students will know the ways they (personally) use energy.

   a. Direct uses.

   b. Indirect uses.

2. Students will know the various ways their society and industry utilize energy.

3. Students will make an analysis of energy uses regarding how much energy is received as compared to the amount needed to produce it.

4. Students will know conservation techniques, including the energy efficiency techniques and how they are applied in homes and industry.

5. Students will understand the consequences of their choices and decisions upon energy problems.

   a. Voluntary.

   b. Mandatory--pricing, rationing.

6. Students will learn that conservation is an alternate energy source.
    a. Historically, resources were treated as unlimited.
    b. Energy conservation is a recent concept that can yield benefits for our society.
    c. Realization that energy resources are limited (therefore, the need for conservation).
    d. Rededication to the conservation ethic.

Goal Number 3:

Understanding the Economics of Energy/Environment Utilization

The economics theme will impinge upon each of the other themes - everything has a cost - and it is important for students to know what these financial and environmental costs are.

Objectives:

1. Students will know the economic perspectives of energy costs.
    a. Every activity involves an energy cost as well as an economic cost.
    b. The real cost of anything is what you give up to get it.
2. Students will know how the individual relates to the economic system in determining energy costs.
    a. Consumption involves both direct and indirect uses of energy and costs.
    b. Production involves both direct and indirect uses of energy and costs.
        (1) Comparison of end-use efficiency costs.
        (2) Conversion of energy vs. additional capital costs.
        (3) Funds spent on research and development may make new sources of energy competitive with current sources of energy.
3. Students will know how pricing influences energy costs.
    a. The laws of supply and demand in an open market.
    b. The laws of supply and demand in a regulated market.
4. Students will learn how political and economic decisions are intertwined.

Goal Number 4:

Understanding the Political Aspects of the Energy/Environment Problem

Whether the international, national, or local political window is being viewed, students need to know how foreign nations, along with national and local political leaders influence the solutions to broad-based problems of this nature.

Objectives:

1. Students will determine their individual household energy policies.
2. Students will understand the need for a national energy policy.
3. Students will understand what the existing local, state, regional, national, and international policies are, and know they are constantly changing.
4. Students will understand how and why policies are formulated.
5. Students will understand how individuals affect household, local, state, regional, national, and international policy.
6. Students will understand how groups affect household, local, state, regional, national, and international policy.
    a. Consumers
    b. Conservation
    c. Labor
    d. Business
    e. Cartels
    f. Trade organizations
    g. Regulatory bodies
7. Students will perform a critique of existing energy policies to determine their effectiveness.
8. Students will be able to analyze information to determine bias as a means of making informed political decisions.

Goal Number 5:

Learning About the Social Aspects of the Energy/Environment Problem

For the energy problem to be meaningful, it must be felt on the home and neighborhood level. It is at this level that most people will be able to help ameliorate some of the energy problems. After that, people will then be more able to contribute to solving some of the larger social aspects associated with the energy problem.

Objectives:

1. Students will understand relationship between spending patterns and social level.
2. Students will become aware of cultural patterns (Amish, poor, affluent, other countries, etc.).
3. Students will understand social responsibility for energy consumption.
4. Students will understand how energy costs and energy policies affect different social groups to different degrees.
5. Students will understand the effect of limited natural resources upon different social groups.
6. Students will become aware of the effect of limited natural resources upon lifestyles.
7. Students will understand how energy costs cause social disruptions.
8. Students will understand how to analyze information to determine social and environmental effects that result from various energy policies.
9. Students will gain ability to analyze information to determine credibility of energy concerns.
10. Students will analyze willingness (of society) to try new solutions to overcome energy problems.

FACT SHEETS*

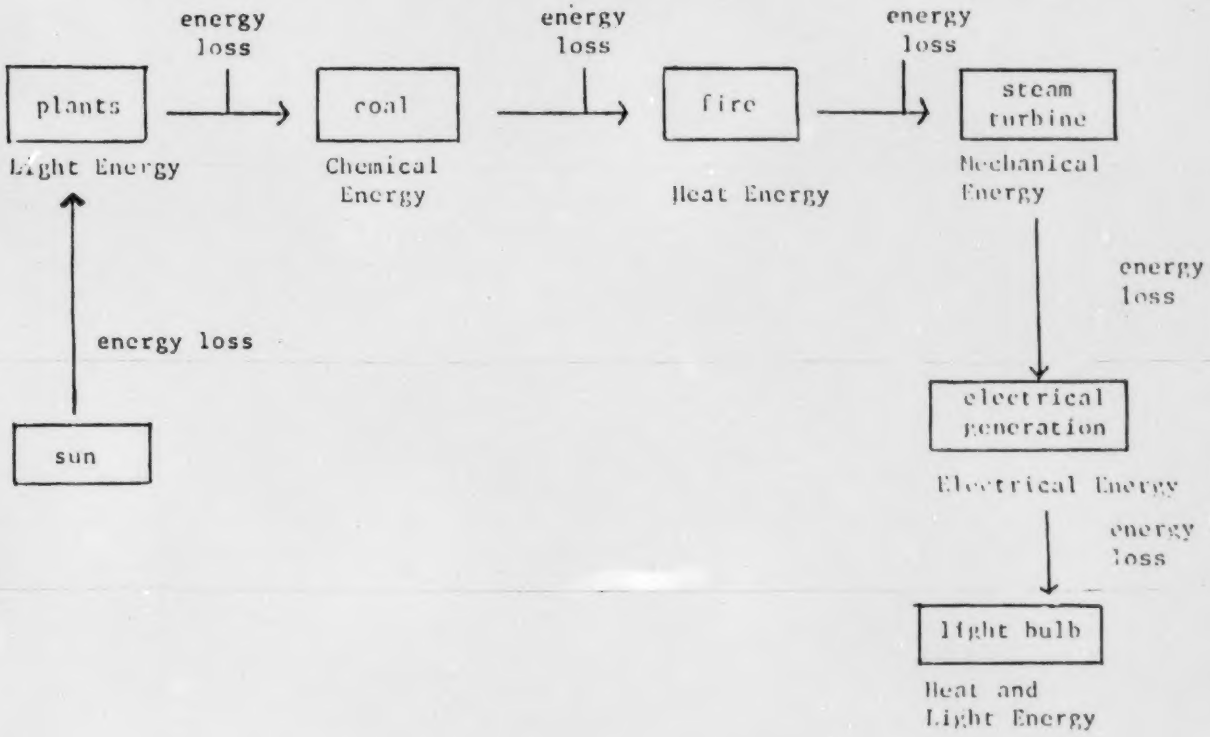
Introduction

What is Energy?

Energy equals the capacity to do work, and power is the rate at which work is done. The work it does allows the biosphere to operate and allows us to maintain our agricultural and industrial civilization. Radiant energy flowing from the sun warms the earth to temperatures which sustain life, drives the hydrological cycle of evaporation and precipitation, powers the winds and ocean currents, and is captured by the green plant which is the food base for most living things. The plant was also the starting point of fossil fuels.

Two ideas about energy are important in understanding energy problems:

1. Energy is not really consumed, but only changed in form. For example, energy could flow through the system diagrammed below:


energy loss
energy loss
energy loss
plants
coal
fire
steam turbine
Light Energy
Chemical Energy
Heat Energy
Mechanical Energy
energy loss
energy loss
sun
electrical generation
Electrical Energy
energy loss
light bulb
Heat and Light Energy

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*Taken from Energy for Today and Tomorrow, a San Diego City/County Schools Publication.

2. When energy is converted from one form to another as shown above, not all the energy is changed to the new form - some is lost or wasted.

   The more conversions between the primary source of energy and the final use of energy, the greater the energy waste.

   This wasted energy cannot be recycled. Since it can no longer be put to productive use, it is lost.

   The primary energy sources are solar, hydro, coal, wind, petroleum and natural gas, nuclear and geothermal.

Energy in San Diego

According to R. R. Higgins, Economist with San Diego Gas and Electric Company,

> ".... There are no commercially developed natural fuel resources in the county of the types which could be used by San Diego Gas and Electric Company. Over the years there have been unsuccessful explorations for petroleum and petroleum by-products in various parts of the county both on-shore and off-shore. Due to the scarcity of natural water, there is no hydro-electric potential within the county and no prospects for such. SDG&E is currently exploring the potential for geothermal fluids as an energy source. However, the geothermal wells which we are attempting to develop are located in Imperial County. The potential energy in tidal wave action has been harnessed for electric generation in very few cases in other parts of the world where the particular topography lends itself to the economic use of this energy as it does not in San Diego County. SDG&E is currently researching various methods of harnessing solar energy. However, we do not consider this form of energy to be a practical, large scale energy source in the immediate future. We are aware of a few windmill installations within our service area which provide at least part of the users' energy requirements. Here again, we do not feel wind power is a practical source of energy in the county.
>
> SDG&E is cooperating with a petroleum company which plans to build an oil refinery in the Carlsbad area. The developing company, Pacific Resources In., also plans to produce synthetic gas as a by-product of the refinery operation. Some or all of this gas would be purchased by SDG&E for distribution to its customers in San Diego County. The crude oil source of the refinery products, however, would be from outside the continental United States.
>
> In summary, San Diego County is blessed in many ways. However, it is not blessed with a practical source of energy of the type needed to supply electric and gas service."

The following fact sheets give you some basic information on the different energy sources.

ENERGY SOURCE FACT SHEET

COAL

Source

Underground, throughout the world (See World Book Encyclopedia Yearbook, 1974).

Collection

Underground and open pit mining

Transportation

Railroad, truck, barge, freighter

Storage

Stockpiles of mined coal

Use

Fuel to create heat for home and industry and to create electric power. A lot of coal is also used in making steel.

Consequences

Health hazards in mining coal; strip mining destroys surface environments; pollution from ashes, sulfur dioxide carbon dioxide, and carbon monoxide. New methods of mining coal, such as by gasification, are too expensive to use at the present time.

Availability

At the present rate of use, America's coal will last 650 years. The supply has not been used extensively in recent times due to the availability of petroleum products and the environmental concerns of mining and air pollution.

What is Coal?

Coal is a fossil fuel formed from dead plants and animals whose organic material is converted to coal by heat and pressure. It takes about 25 million years for coal to be formed.

Coal is burned to release its stored chemical energy. At present, coal provides about 20% of the United States' total energy use. Of the fossil fuels, America has more coal than oil or natural gas.

However, burning of coal can have harmful environmental effects. Coal often contains sulfur which creates a health hazard by becoming sulfur dioxide when the coal is burned. This burning also produces ashes and carbon dioxide. Some people fear that increased amounts of this gas in the air may change the weather. Present pollution control methods are very expensive. Furthermore, underground mining of coal is hazardous for miners. When the ground is stripped (like peeling an orange) to get the coal (strip mining), the earth is badly damaged. The environmental problems include what to do with the unsightly appearance, acids formed by water and leftover sulphur, ruined streams and groundwater sources, and hills of leftover dirt.

All of these environmental problems will have to be solved if coal is to be used as a major energy source. Coal is no longer used in California because of transportation and environmental considerations. However, several utility companies are currently studying its possible future use.

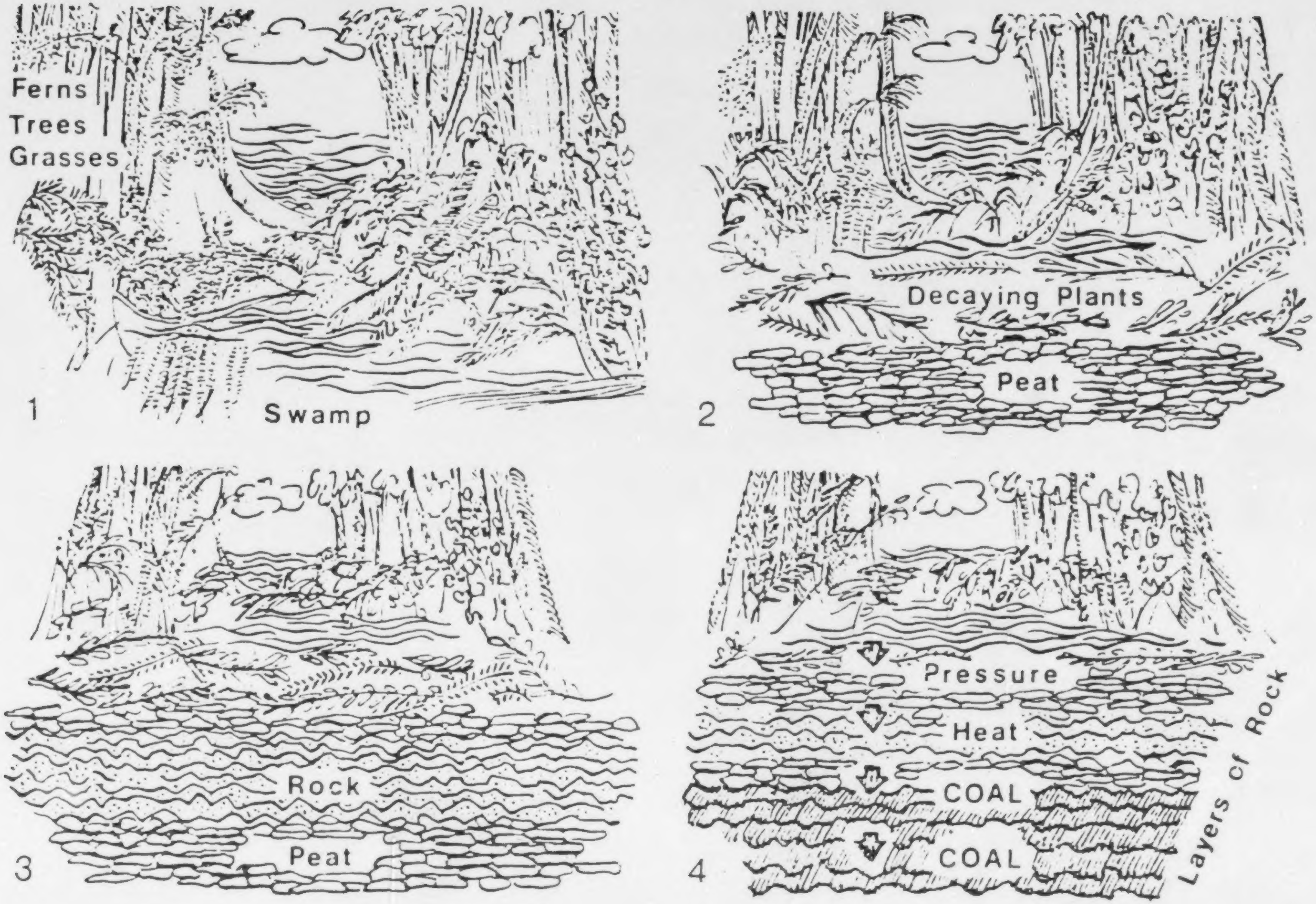
New Ideas

Some scientists think coal gasification will help solve the environmental problems. They want to set an underground coal seam on fire, then collect the gases which result. This method would get the energy value of coal without disturbing the surface environment or subjecting workers to underground mining hazards. Technology for this method needs improvement, however, and costs are high.

Cost

As of 1974, it would cost about$218 per year to heat a California home directly with coal if its use were permitted. This cost will go up as other fuels become scarce and the mining costs (labor, machinery, environmentsl, and health) increase.

HOW COAL WAS FORMED


Ferns
Trees
Grasses
1
Swamp
Decaying Plants
Peat
2
Rock
Peat
3
Pressure
Heat
COAL
COAL
4
Layers of Rock

ENERGY SOURCE FACT SHEET

CONSERVATION

Source

Available from all other sources of energy

Collection

None

Transportation

None

Storage

None

Use

Conservation will make exhaustible energy resources last longer and cost less.

Consequences

By conserving energy--that is, using less energy or using energy more efficiently--consumers or businesses save money. Conservation saves money for all of us because saved energy used somewhere else is cheaper than producing more new energy.

Availability

Conservation energy is available immediately, and the supply will last for as long as people are willing to make the effort.

What is Conservation Energy?

Conservation can be considered as an alternative source of energy. The technology now available, combined with strong conservation effort, would produce enough energy to maintain our present standard of living in the face of dwindling energy supplies.

Money must often be spent to conserve energy for other uses. An example is insulating and updating homes and buildings. However, this expense is less than the cost of producing the extra energy used by inefficient consumers. The more efficient use of energy also means an increase in the number of jobs created for each dollar of capital invested.

Conservation increases supply with the lowest risk. Many ways to conserve have been proven and the cost can be paid gradually in small steps. Once conservation improvements are made, there is no danger of this energy supply being cut off by foreign governments or changes in federal rules. Also, conservation is not likely to have a negative impact on the environment in the future.

Improved efficiency in energy use is the first step towards a basically different view of energy and the earth's physical resources. For this change each human being must recognize the limited nature of conventional energy resources. Moreover, each person must consider the serious environmental effects of the way we now obtain and use energy. In the long run, energy conservation efforts can show us how to balance our production and daily use of energy with the earth's ability to absorb wastes.

ENERGY SOURCE FACT SHEET

GEOTHERMAL ENERGY

Source

Earth heat in steam, hot water, and hot rock generally found where large amounts of molten rock lie near the surface ground. This heats deep underground bodies of water trapped in rock.

Collection

Steam or hot water rising to the surface

Transportation

Via pipes to (on site or adjacent) power plants

Storage

None after steam or hot water has been released

Use

Steam or hot water provides power to generate electricity

Consequences

Problems with disposal of waste water; high concentrations of minerals in water corrode turbines and pipes; foul smelling gases may be released into the air. Some experts worry that withdrawal of fluids may start underground earth movements. Onsite power conversion and return of water underground would eliminate some of these problems. If great amounts of heat are withdrawn from the interior of the earth, are there unknown thermal consequences?

Availability

Limited to these parts of the United States (mostly the western states) where geysers are found. The location of geothermal fields limits use of this energy source mostly to small cities in the western states.

What Is Geothermal Energy?

It is earth heat that might be able to provide much of the earth's energy. When underground heat meets underground water, hot water or steam is produced. Then steam may come up naturally as a geyser (Old Faithful) or a hot spring (Warner Hot Springs). See diagram on next page. There are several projected areas of development in California. At present, there are no geothermal wells being considered for power production in San Diego County. See diagram on next page.

By tapping 13% of the total heat from geothermal sources, we could generate enough electric power to equal 10 times our present energy output. Known geothermal sources are large and in general, easily developed. However, they are located mostly in the western states of the United States.

There are production as well as environmental problems associated with this energy source. Sometimes the water has a high level of minerals. This corrodes and clogs pipes and turbines if not removed and makes getting rid of waste waters difficult. The smelly gases, sulfur, ammonia, and boron released into the air cause pollution. There are worries that injection and withdrawals of water may trigger earth movements. The release of steam and hot water under pressure also causes noise (like a jet plane taking off) and odor. Many of these problems can be bypassed by using different methods of converting the available heat energy to electric power.

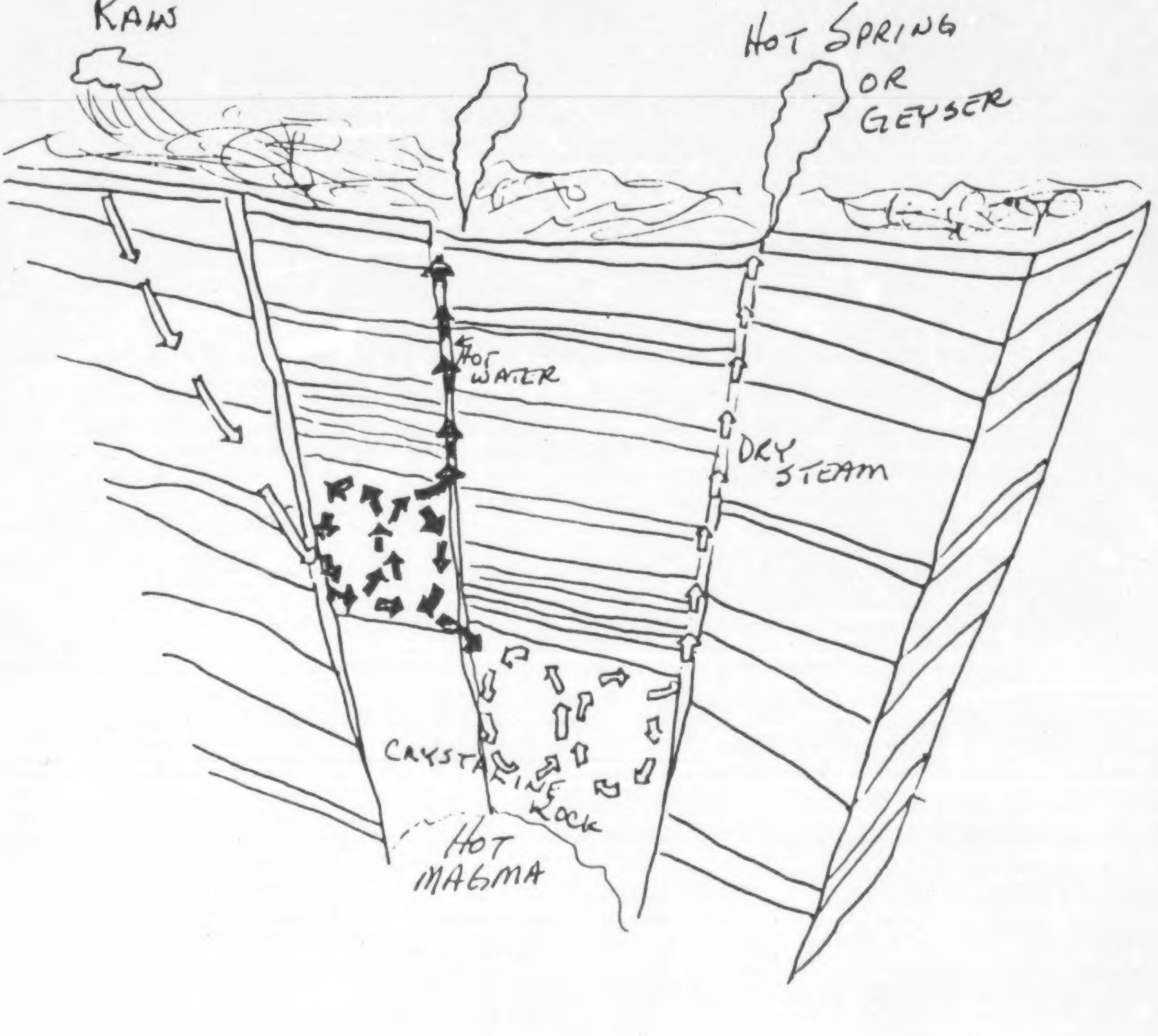
In addition, many of the good locations for geothermal power are in scenic areas such as Yellowstone National Park. Many people may not like changing those landscapes by adding electric powerplants. However, it does not affect the land the way mining does nor have the waste problems of fossil or nuclear fuels.

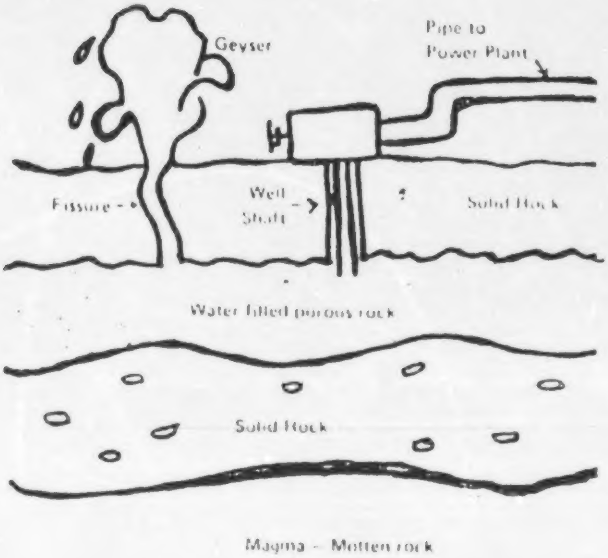
New Ideas

Some scientists are trying to find ways to circulate water through hot rocks which are not near underground water systems. If this happens, we could develop more geothermal sources.

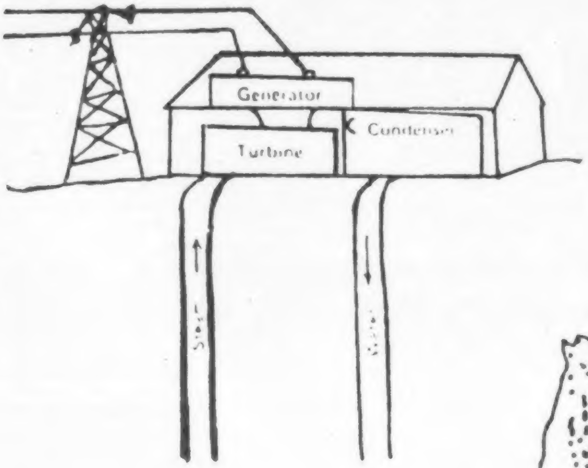
Cost

Costs are relatively low. Natural steam used to generate electricity is cheaper than oil, coal, or nuclear power. In areas of California where it is available, it would cost about $172 to heat a house (1974 rates).

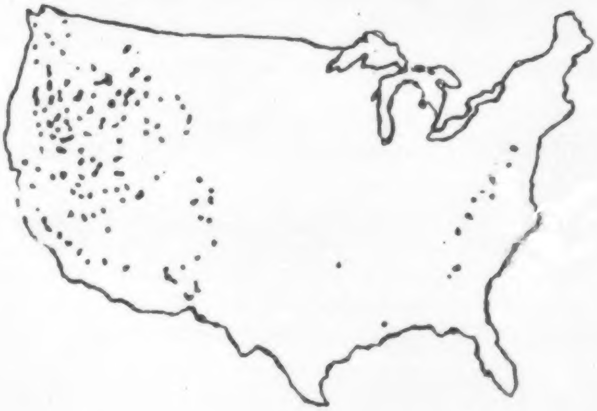

RAIN
HOT SPRING OR GEYSER
HOT WATER
DRY STEAM
CRYSTALINE ROCK
HOT MAGMA


Geyser
Pipe to
Power Plant
Fissure
Well
Shaft
Solid Rock
Water filled porous rock
Solid Rock
Magma – Molten rock

Today, steam rising from the earth is used to turn a turbine to generate electricity. See diagram below.


Generator
Condenser
Turbine
Steam
Water

Map of Geothermal Regions



ENERGY SOURCE FACT SHEET

HYDROPOWER

Source

Streams, rivers, rain, snowmelt

Collection

Dams, natural waterfalls, lakes, streams, rivers

Transportation

Canals, flumes, chutes, aqueducts, pipelines, rivers

Storage

Reservoirs, pump storage

Use

To generate electric power

Consequences

Sediment filling up lake; loss of valuable farm land; destruction of animal habitats; high cost of constructing dams; limited life span of dams; hazards to life and property if it breaks.

Availability

For the sole purpose of creating electricity with no consideration to agriculture river ecosystems and aesthetics, it would require damming all major rivers to produce one half of the world's present power expenditure. Few new dam sites are available.

What is Hydroelectric?

Hydroelectric energy accounts for a small portion of electrical energy needs (about 4%). Hydroelectric energy is a clean source of power, but there are many environmental and social consequences. Damming buries large amounts of the best agricultural lands at a time when we cannot afford to lose them. In many cases, the lake behind a hydroelectric power dam starts filling with sediment and slowly renders it useless. In addition, it reduces the natural flow of sediment to the oceans, thus reducing the amount of sand for beaches.

Cost

The cost of hydroelectric power generation is also significant. Some experts estimate a life expectancy of as little as 10 years for a dam, due to sediment filling in the lake. Others estimate as much as 1,000 years of "life" for a typical dam. There is also an effect on wildlife because the sediment chokes out fish mating and spawning beds and destroys water vegetation. Probably the most important roadblock in the development of this source of energy is the lack of natural sites in the United States. Also, the high cost of building a dam limits the use of hydroelectric power in the future.

ENERGY SOURCE FACT SHEET

NUCLEAR FISSION

Source

Unanium 235, thorium, and plutonium in controlled nuclear reactions

Collection

Uranium and thorium are mined from the ground, then processed and enriched. Plutonium is produced as a byproduct in nuclear reactors.

Transportation

Fission fuels are carried in large casks made of lead and steel. These casks can survive through any foreseeable accident. They may be carried by rail or truck. The quantities of fuels needing transport are small due to the high energy content.

Storage

Fissionable materials may be stored for long periods of time in shielded locations.

Use

Nuclear fission makes heat which is used to boil water, making steam to run turbines which turn generators to make electricity. Other uses are desalting seawater, making hydrogen, coal gasification, and as a powerplant for ships and spacecraft.

Consequences

Much of the waste fuel must be kept away from living things for up to 250,000 years, (depending on the treatment of waste before storage, estimates of the time vary from six hundred years to several hundred thousand years). A nuclear reactor accident, such as the reactor core overheating, could cause the core to melt. It is considered possible that the water intended to cool the core might change to steam causing the protective shell to break and spread radioactive material over a wide area.

Availability

Sixty nuclear powerplants provide over 8% of our total electric power today. Estimates are about 35-40% of our electricity will come from nuclear fission plants in 1990. Uranium resources at these increasing rates of use will last about 30 years. If breeder reactors--they make (breed) another fuel (plutonium) as they use uranium and thorium--are built the supply may last 1500 years or more.

What is Nuclear Fission?

In fission, Uranium 235 atoms or other similar atoms are split into two or more fragments to release energy as heat.

There are two types of fission powerplants. One is called a Light Water Reactor. It uses water to heat other water to make steam to turn the generators. This requires a lot of cooling water. The second is a High Temperature Gas Reactor. This uses helium heated by the reactor which in turn heats the steam to turn the generators. One model uses helium itself to turn the generators. Of the two reactors, the High Temperature Gas Reactor is more efficient, producing more energy from a given amount of fuel.

Nuclear fission could be the way to provide lots of energy, save present energy sources (oil and natural gas), reduce fossil fuel air pollution, and produce other energy (hydrogen and coal gasification). This would help bridge the gap between the fossil fuel age and fusion power.

Even though nuclear energy may be an economical way to generate electricity, nuclear power reactors produce hazardous liquid and solid wastes. Much of this waste must be stored without any contact with the environment for up to 250,000 years.

Another danger is the possibility of a major accident such as a reactor core overheating. This could result in a hazardous leakage of radiation into the environment. Some experts say the chance of this is really quite small, perhaps as little as one in a billion.

Finally, there is the problem of security in the transport and storage of radioactive material.

Most of the problems mentioned above might (and likely will), be solved with good management and better technology, and probably will be solved. The question is whether it is worth the risk today and for future generations.

Cost

The cost of nuclear electric power is about the same as the cost of power from fossil fuels. Heating a home in California would cost about $510 per year.

SOURCES IN SAN DIEGO COUNTY

In San Diego County, the San Onofre nuclear generating station south of San Clemente is a functioning nuclear power plant. This 450 megawatt unit has been in operation since 1968. At present, two additional units are under construction at the San Onofre site, each of which will produce 1,180 megawatts. To produce the output of these two units in a fossil-fueled plant, it would require the burning of an estimated 25 to 30 million barrels of oil a year. Commercial operation of these two plants is planned for 1981 and 1982.

ENERGY SOURCE FACT SHEET

NUCLEAR FUSION

Source

Hydrogen isotopes in a controlled thermonuclear reaction

Collection

The hydrogen isotopes are separated from common water, (or sea water).

Transportation

The fuel for the fusion reaction would probably be moved in tanks as a compressed gas. It would be used in fusion reactors to generate electricity.

Storage

Electrical power can be stored in pumped water storage, hydrogen (and later run through a fuel cell), or in a large battery bank.

Use

Generation of electricity; separation of hydrogen from water; changing radioactive wastes into harmless substances; desalting seawater.

Consequences

If fusion can be developed, there is enough fuel on earth to produce hundreds of times as much power as used today for millions of years. This power would be generated almost pollution free.

Availability

Is still in the research stages. General Atomic anticipates the first demonstration power reactor to be operating in the 1990's. Operating powerplants will not be providing much of the United States' energy needs in the first decade of the 21st century. Nuclear fusion is not a solution to energy needs of the immediate future.

What is Nuclear Fusion?

In a fusion reaction, light atoms (such as hydrogen isotopes) are forced together under great pressure. During this change, large amounts of energy are released.

The U.S. Department of Energy (DOE) believes the first small-scale experimental fusion reactor will be working by the late 1980's, and a scaled-up demonstration fusion reactor by the late 1990's.

ORGANIC WASTE AND REFUSE

Source

Urban and agricultural wastes

Collection

Garbage collection, sewage, industrial refuse

Transportation

Trucks, sewer systems

Storage

Dumps, sewer treatment plants, municipal garbage incinerators

Use

Decomposition produces methane gas (like natural gas) which could be used as a fuel for heat. Flammable wastes can also be used as a fuel.

Consequences

Cost of building municipal methane plants and family-size converters would be offset by the production of a usable fuel. Methane gas would help to replace dwindling supplies of natural gas. Burning waste produces smoke and fumes which must be controlled to prevent air pollution.

Availability

The energy potential from waste could be expected to provide up to 3% of the total United States' energy needs, or up to 10% of our electrical needs.

What Is Organic Waste and Refuse Energy?

It comes from converting city and farm organic wastes to methane gas and would reduce the huge mass of refuse in this country by half or more. As a bonus, these new supplies of methane would serve to conserve or replace the dwindling fossil deposits of natural gas (primarily methane gas).

Consider these statistics: About 1.5 billion tons of city and farm waste are produced each year. This waste will increase as the population grows. Each pound of organic waste will produce about ten cubic feet (.29 m^3 of methane gas. If all this waste were processed for methane gas (probably an impossible task), we could have about 30 trillion cubic feet (857 billion m^3) of methane each year. This is about half again as much natural gas as the United States uses at this time. However, if conservation efforts to reduce waste are successful, less waste will be available as a source of energy.

Every city sanitation facility in the country could include a methane converter facility. Also possible, would be a family-size garbage converter attached to the house that could provide much of the fuel needed for cooking and heating. Production of methane gas from organic wastes and refuse could contribute to solving tomorrow's energy and waste-disposal problems.

Cost

To convert refuse to fuel is more expensive than present waste disposal techniques and exploration for offshore natural gas. But its potential makes it a logical choice as an alternative energy source.

ENERGY SOURCE FACT SHEET

PETROLEUM (OIL)

Source

Underground deposits throughout the world (under the sea floor in some locations)

Collection

Oil drilling

Transportation

Pipelines, oil tankers (truck, railroad, seagoing tankers)

Storage

Above-ground and underground storage tanks

Use

Fuel for producing heat which can be used to generate electricity or to produce mechanical energy; fuel for transportation and heating; raw material for petroleum based products and chemicals (plastics).

Consequences

Limited supply, high cost and supply uncertainties of imported oil; environmental impact and cost of drilling for new sources (e.g., offshore drilling); risks in transporting crude oil via pipeline or tanker (Alaskan pipeline); air pollution problems. Seventy-five percent of the present United States energy requirements are supplied by oil and natural gas.

Availability

Estimates vary, depending on role of use and how much is imported from other countries. At best, relying only on maximum United States resources, we have enough oil to only 35-40 years, or until the year 2015.

What is Petroleum?

Petroleum is fossil fuel made by millions of years of heat and pressure of the earth on organic materials. Petroleum is burned to release its energy.

If petroleum is used at expected rates, experts believe that by the year 2000, 90% of the world's oil may be exhausted. The current American use of oil requires increasing imports from Latin America and the Middle East. This is in addition to the use of the Alaskan pipeline to tap the North Slope oil reserves.

Importing oil has several effects on America. American dollars go out of the country and into oil-producing countries. Increased oil importation requires construction of oil supertankers with offshore ocean terminals. To ease the problems of oil importation, the United States is developing its own oil supplies, including offshore drilling.

However, the use of oil has severe environmental effects. The U.S. Office of Science and Technology reports that motor vehicles account for 44% of the country's air pollutants. Stationary fuel combusion of oil (powerplants and industry accounts for 16%. According to this report, vehicles give off 65% of the carbon monoxide, 46% of the hydrocarbons, and 37% of the nitrogen oxides. In addition to emissions, one must consider the possible environmental cost of more oil spills and petroleum-related pollution of the ocean, lakes and streams.

The environmental impact of oil utilization can be reduced through techniques such as hydrogenation to yield sulfur-free fuel. Exhaust emission control systems somewhat reduce the harmful effects of automobile emissions, but the cost and increased fuel consumption caused by these devices is considerable.

Oil shale (a limestone-like rock that is heated to release it oil) could also be used to increase petroleum supplies. Of course, getting oil shale presents all the usual mining problems plus the negative effect on the land at and near the mine sites. Large quantities of water are used in this process. The limited supply of water available in the areas where oil shale is found has restricted the use of this resource. Some experts estimate that energy expended to extract oil from shale may well equal if not exceed the energy the shale will provide.

Cost

As of 1974, heating an average home in California using only oil would cost $210.

SEA POWER (TIDAL, SEA THERMAL, AND WAVES)

Source

Oceans, currents, tides, and waves

Collection

Turbines run by incoming and outgoing tides or ocean currents; generating plants 200 feet (61m) beneath the surface of the sea (thermal); storing water in tanks above sea level; or using floats to operate booms which turn a generator.

Transportation

Varies depending on the form of collection

Storage

Hydrogen gas in tanks for electrical storage, batteries, and water in tanks above sea level for waves.

Use

Generate electricity, or in the case of sea thermal, hydrogen to produce heat or electricity

Consequences

Restrictions on recreation and fishing near these plants and cluttered beach areas

Availability

There are few places in the world where there is enough variation in tides to generate electricity efficiently. Limited number of sites for sea thermal, changes in wave power, and the number of waves limit the places where this power is feasible. Major ocean currents are often not close to land.

What is Sea Power?

Tidal sea power is possible along a coast where there is a high rise in tide. At high tide water flows through turbines into a bay, and during low tide, it flows back out. Conversion to energy is possible only during tidal flow, about 3-1/4 hours each way twice a day along the Pacific coast. Thus energy is generated for only 13 out of 24 hours. There are only a few places in the whole world where this is practical.

Sea thermal power is possible because of the difference between surface, warm sea temperature, and cold, deep water temperature. A gas (like freon used in refrigerators) at sea level would turn a generator, then be pumped deep to be cooled into a liquid, and then be brought to the surface to expand into a gas and turn the turbine. The electricity generated would be transported to shore through cables.

Waves could generate electricity by forcing water through valves in pipes into a tank above sea level. This water would run a turbine on its way back to sea. Or, floats could be mounted along the shoreline, connected with the shore by a long boom. The up-and-down motion of each boom would turn a generator.

Cost

Costs for these ideas are fairly high, too high in comparison to present alternatives. Also, the efficiency factor is low, with the possible exception of the sea thermal alternative. Costs are roughly twice as much as conventional power plants.

FACT SHEET

SOLAR ENERGY

Source: Sunlight

Collection: Photo cells (photovoltaics): metal panels, metal or plastic piping, plastic or rubber hose containing water or air to be heated, collected through photosynthesis in plant life; "solar farms".

Transportation: Varies, depending on the form of collection.

Storage: Heated water, heated air, batteries, and stored in the form of plant tissue through photosynthesis.

Use: Can be converted directly to electricity, used to heat water which in turn can power generators to create electricity, convert to nonpolluting fuels like methane and hydrogen, food energy in plants.

In order to gather solar energy, large arrays must be built. It is estimated (IPRI) that 47 square miles of solar arrays (collectors) would be required to produce 1 billion watts of electrical energy.

The Department of Energy report "Distributed Energy Systems in California's Future' says 70 square miles of land will be required to produce 100 million watts of electrical energy.

The conversion of light rather than heat into electricity involves photovoltaic conversion whereby solar cells exposed to the sun deliver electric current. Cadmium sulfide and crystal silicon cells are expensive to produce. Based upon present technology using solar cells to generate electricity is still 100-200 times more expensive than using conventional nuclear fueled plants.

The use of solar energy to assist in space and water heating may reduce somewhat the dependence upon fossil fuels for heating.

ENERGY SOURCE FACT SHEET

WIND

Source

A daytime heating and nighttime cooling of the atmosphere which produces winds.

Collection

Windmills, sails, wind turbines

Transportation

By wire (when used to produce electricity): by pipe, truck, or ship (when used to produce hydrogen)

Storage

None directly; as hydrogen gas in tanks. Storage possibilities for mechanical and electrical energy include improved batteries, flywheels, pumped water storage (pumping water to an elevated tank, then releasing the water to drive turbines), and compressed air storage.

Use

Wind can be used as kinetic energy (as with sail boats), or converted to mechanical, electrical or chemical energy.

Consequences

Low cost, renewability, and the fact that the methods of harnessing wind power do not degrade the environment give this source of energy a good potential. However, many windmills spread across a mountain range, open plain, or valley might be unsightly. A Department of Energy official has calculated that it would take 1,500 windmills with 300 foot-long blades to generate 1 billion watts of electricity. He added,"That would be a row of windmills 870 miles long, all taller than the Coronado Bridge." Wind power requires 10,000 times more space than coal or nuclear power plants.

Availability

Wind power can be used almost immediately on both large and small scales. The technology to use this source of power is already available for small-scale use and there should be little difficulty in designing efficient large-scale systems.

What Is Wind Power?

For over 4,000 years wind has been used to produce power for pumping water, milling grain, and moving vehicles such as boats. Recently our use of wind as an energy source has declined because it was thought that there were other cheap fuels (petroleum, coal, nuclear, and hydroelectric). However, costs of fossil fuels have gone up as the supply as gone down. There are few new sites available for hydroelectric power. There are environmental worries about nuclear energy. All these have given renewed hope for wind as a significant power source.

Frank Rom of NASA thinks that half the electric power needs of the United States could be met by placing wind machines, one per square mile, throughout the Great Plains of the Midwest. Another possibility might be to place windmills on floating platforms off the Atlantic or Pacific Coasts. Of course, there are problems with unreliable wind speeds. Some of these could be overcome by moving many windmills into areas where wind is strong, steady, and predictable.

To solve the problems of unpredictability and storage of wind generated power, different systems to convert and store the power are now possible. One solution is to use wind power to electrolyze water. This will produce hydrogen gas, a flammable fuel which could then be stored and transported through pipelines as needed. Improved batteries, flywheels, pumped storage of water, and compressed storage of air are also possible answers.

The major project now is to design efficient, economical windmills to aid energy needs in both developed and developing nations. It is possible that small windmills, along with solar energy absorbers and waste recyclers, could provide total energy needs for individual homes.

Wind power is self-renewing, nonpolluting and plentiful. It shows high promise as a major source for our future energy needs.

Cost

Cost for wind generated power on a small scale (individual homes or farms) is about the same or a little more than current electrical costs. Large-scale operations are presently more expensive; low mass production techniques and higher fuel costs will soon make them equal.